ORTHOPAEDIC NURSING

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DEDICATED

TO THE MEMORY OF

DAME AGNES HUNT

AND TO THE STUDENT NURSES OF THE HOSPITAL WHICH BEARS HER NAME

FOREWORD

MISS POWELL knows all the tricks of orthopaedic nursing —how to make a splint comfortable while at the same time it does its job, how to apply plaster of Paris casts and fit supports and appliances, and even how to correct flexion contracture of the knee joint in a Thomas splint—a rapidly disappearing art. Moreover she can teach others to do the same. Never before have the details of orthopaedic nursing been presented with greater clarity

But this book reflects much more of the inheritance of Agnes Hunt than simple technical skill. It reflects the very spirit of that Florence Nightingale of orthopaedic nursing who said that the essential qualities of a nurse were "commonsense, gentleness, kindness and the power of giving hope and joy to those who are suffering." Miss Powell has given hope and joy to many thousands of patients, and this is self-evident from the pages of her book. We are grateful to her for upholding a tradition so worthily

R Watson-Jones

1951

PREFACE

THIS book is written primarily for nurses and physiotherapist working in orthopaedic hospitals while training for the Orthopaedic Nursing Certificate. It is also hoped that it will prove useful to those engaged in orthopaedics in the wards and departments of general hospitals, and to those working in sanatoria where bone and joint tuberculosis may accompany a pulmonary lesion.

It is based on the teachings of our great founder Dame Agnes Hunt the pioneer of orthopaedic nursing and herself the victim of a crippling disease. Her nurses were trained by allocating to each one her own group of patients, praise or blame being meted out where it was due. Appreciating the value of fresh air and sunshine freely movable beds were used so that patients could be wheeled out of their wards not only for treatment but for recreation. No "visiting hours" other than those governed by the patient's treatment were countenanced. Her flat refusal to have a polished floor in any part of the hospital was typical: she taught that tidy wards and tidy beds are unimportant compared with the comfort and happiness of the patient. Her example and exhortations were to "bring up" children, to encourage them to laugh and play, to treat them in fact as our own. Rules and regulations were cut to a minimum, but in spite of this, the mature type of discipline which springs from *esprit de corps* was exercised over patients and staff. The teaching of less tangible things—that the proper treatment of the orthopaedic patient lies not only in the care of his body but in the creation of an atmosphere of hope, of happiness, of security and homeliness—was not forgotten. These teachings are followed to this day at Oswestry and this book will permanently record however inadequately the admirable lessons which have been handed down mainly by word of mouth thus bringing to a wider circle the benefit of her wise counsel.

For valuable assistance I am indebted to many people. Firstly to Sister Carrie Johnson who has been a tower of strength and who has led the staff at Aston in loyalty and sup-

port. My thanks are also due to Mr John C Menzies for his help in preparing the manuscript, to Miss Bell for forbearance and support, to Mr Marrow, Mr Jagger and Miss Cookson for preparing the photographs, to Miss Buckley and Miss Morris for typing the manuscript, and to Mrs. Harris-Temple for helping to prepare the index. I am immeasurably grateful to my friends and colleagues Miss Mona Williams and Sister Arthur, whose work embodies the highest traditions of orthopaedics; Miss Williams has contributed the chapter on "After-care" and Sister Arthur has given me over many years the benefit of her advice and the example of her own superlative plaster technique. I would like to thank Mr Rhaiadr Jones for his assistance with the chapter on splints; most of those described were made in the Derwen Cripples Workshops.

I am deeply grateful to Sir Reginald Watson-Jones for writing the Foreword and allowing me to use illustrations from his book "Fractures and Joint Injuries." My thanks are also due to Mr Farquharson for photographs from "Illustrations of Surgical Treatment" to Mr Naylor for illustrations from "Fractures and Orthopaedic Surgery for Nurses and Masseuses," and to Mr Alexander Miller for lending photographs. I would like to thank Livingstones for their care and efficiency in producing the book, and Mr Charles Macmillan for his personal interest throughout. Finally, my warmest thanks go to Mr James Wishart, without whose help this book would never have been completed.

MARY POWELL

Aston Hall
1951

CONTENTS

known as an orthopaedic conscience that is, she will never allow anything which interferes with the patient's treatment to escape her notice or to remain uncorrected, even for a moment, so far as it lies in her power. For instance, if the surgeon orders continuous traction to a limb the nurse will see that it is in fact maintained continuously no matter what the circumstances.

A patient with an acute abdominal condition may be in hospital for a few weeks *a patient with an orthopaedic condition may be in hospital for many months or even years*. Almost any one can rise to the occasion when nursing an acute surgical case but it requires the highest qualities of patience and skill to maintain the health and morale of a patient during many months of treatment in hospital. To the uninitiated, and especially to the nurse who is accustomed to the alarums and excursions of a general hospital orthopaedic nursing may seem a little tedious. But once she achieves an understanding of the principles of treatment and of the enormous contribution she can make to the patient's recovery her work can never seem dull or unimportant.

Nursing of whatever kind is the art of tending the sick it is essentially practical and cannot be learned from books alone. This book is written in the hope that it will assist the orthopaedic nurse to a deeper knowledge of the needs of her patients, so that she can develop her art to the highest degree.

Some notes on posture, the normal curves of the body, muscle action, the movements of joints, and deformity

Since orthopaedic work is concerned with the form and function of the body a knowledge of the normal position structure and function of bones, joints and muscles must be acquired by the student. The following notes may be found helpful.

The surface contours of the body vary enormously in different subjects, despite the fundamental similarity of structure, and are greatly influenced by the muscular development and the amount of sub-cutaneous fat. There are also great differences of habit in what is known as *posture* meaning the attitude or carriage of the body. The *stance* and *gait* also vary in diff

erent individuals, as evidenced by one's ability to recognise people by a characteristic attitude or walk

Normal posture. The student must acquire a knowledge of normal posture by observation of the living subject. It is said to be present when the head is held erect the chin in the spine straight and presenting its normal curves the shoulders level the pelvis level, the chest arched, and the belly flat the hips and knees in extension, and the feet in the plantar-grade position.

Posture is greatly influenced by the build of the individual, difference in bodily structure producing many variations within the normal pattern It is also influenced by what is known as *muscle tone* This is a state of tension in muscle which is maintained by reflex action Afferent impulses pass to the central nervous system from end-organs in muscles, tendons, and joints and from the vestibular apparatus and the eyes these are answered by afferent impulses which maintain a partial contraction of the muscles. Only a few muscle fibres are innervated at one time so that fatigue is avoided. The degree of reflex tension depends upon the state of the central nervous system, and is also related to the attitude adopted by the subject

The normal curves of the body *The spine* presents four antero-posterior curves, viz. —the dorsal and pelvic curves, concave forwards, and the cervical and lumbar curves, concave backwards. The dorsal and pelvic curves are developed first the cervical curve appears as the growing baby raises his head, and the lumbar curve as walking commences. The lumbar curve is always more marked in females than in males due to the greater forward tilt of the pelvis.

The pelvis is normally held so that the anterior superior iliac spines are level and in the same vertical plane as the symphysis pubis. The female pelvis is wider and its forward inclination more marked than in the male

The lower limbs. The femur inclines slightly inwards and presents a mild forward bowing The inward inclination is accentuated in females owing to the greater width of the pelvis. The tibia inclines very slightly forward and outwards. In the normal subject both knees and both malleoli touch in the standing position, and the feet should point straight forwards.

The upper limbs. The height at which the shoulders are

act as supporting structures. The degree of movement of which each joint is capable and the means by which it is normally limited should also be studied.

Limitation of joint movement is due to:—(1) the shape of the constituent bones (2) the restraint of the ligaments (3) the resistance of muscles; (4) contact of the part moved with other structures.

The movement of joints is described as follows —

Flexion or bending *extension* or straightening

Abduction or drawing away from the mid line of the body

Adduction or drawing towards the mid line of the body

Internal and external rotation or rolling towards or away from the mid line of the body

Circumduction is a combination of all these movements.

Individual joints will now be considered.

The vertebral column is a flexible rod capable of a wide range of movement —flexion, extension, side-bending and rotation

The shoulder joint is a ball and socket joint and its movements are greatly aided by the movements of the scapula on the chest wall as seen by the comparatively wide range of movement which can be developed when the joint is fixed, e.g by arthrodesis. The glenoid cavity is shallow and does not enclose the humeral head firmly so that the joint is easily dislocated especially if its muscular supports are lost as for example in poliomyelitis. Movements permitted are flexion, extension abduction adduction and circumduction.

The elbow joint is a hinge joint permitting flexion and extension.

Supination turning the forearm palm upwards and *pronation* turning the forearm palm downwards, occur at the superior and inferior radio-ulnar joints. For this movement to be pure it must be performed with the arm held to the side and the elbow flexed to the right angle otherwise rotation occurs at the shoulder joint

The wrist joint allows of flexion or *palmar flexion* (i.e. in

the direction of the palm) and extension or *dorsi-flexion* abduction or *radial deviation* adduction or *ulnar deviation*.

The first carpo-metacarpal joint of the thumb is capable of very free movement owing to the shape of the articulating surfaces. Movements permitted are abduction, adduction, flexion, extension and circumduction.

Opposition describes the rotary movement of the thumb in approximating to the little finger

The hip-joint is a ball and socket joint similar in construction to the shoulder joint except that the femoral head fits firmly into the acetabulum so that its stability is much greater Movements consist of flexion, extension, abduction, adduction, rotation, and circumduction.

The knee joint is generally described as a hinge joint though some degree of rotation can occur when the joint is flexed. Otherwise movements are flexion and extension. The stability of this joint is greatly dependent on the surrounding musculature notably the quadriceps.

The ankle joint is formed between astragalus below and the mortice of the tibia and fibula above. Movements are flexion or *dorsiflexion* i.e bending towards the body and extension, or *plantar flexion* i.e. bending towards the ground

The joints of the foot produce *inversion* or turning up the inner border of the foot and *eversion* or turning up the outer border of the foot.

Abduction or *adduction* of the foot also occurs at these joints.

The joints of the body are interdependent in that deformity or limitation of movement of on joint often imposes unnatural mechanical strains on others for example dysfunction of the hip-joint may produce disability of the lumbar spine

DEFORMITY

A deformity is a malformation of the body or limb. It may be —(1) *Congenital* that is, present at birth and due to a developmental error or damage to the foetus during pregnancy (2) *Acquired* that is, due to disease or injury

A postural deformity is due to habitual bad position and is capable of being voluntarily corrected by the patient

A structural deformity is due to architectural changes in the part involved, and cannot be voluntarily corrected by the patient

Postural deformities may become structural, as in course of time soft tissues adapt themselves to position and become contracted and skeletal changes eventually follow

Compensation for deformity The body weight must always be kept over the centre of gravity In order to achieve this, a shift of one part of the body will be accompanied by a shift of another part in the opposite direction for example, if one leg is shorter than the other the pelvis on that side will be tilted downwards to allow the foot to reach the ground. A corresponding curve of the lumbar spine will follow and this may be compensated for by a dorsal curve in the opposite direction. Thus it will be seen that each part of the body is mechanically dependent upon the rest.

CHAPTER II

GENERAL PRINCIPLES OF ORTHOPAEDIC TREATMENT

The use of traction. Principles of traction. Types of traction. Method of applying traction. The optimum position for joints. Management of orthopaedic cases. Preparation of patients for examination.

DURING training the nurse may encounter methods of treatment other than those described in this book, but the underlying principles remain the same.

Rest. In many conditions, this requires to be "*enforced*, uninterrupted and prolonged" (Hugh Owen Thomas.) In addition to *general rest* for the whole body *local rest* is provided by splintage.

Treatment of the patient as a whole. This includes occupational and diversional therapy and education, as well as attention to the general physical and mental health. Each case receives individual consideration.

Physiotherapy. This plays an important part in orthopaedic work and in many conditions is an integral part of the treatment. (Chap. III.)

Traction. Traction is used for the following purposes:— (a) To gain or maintain bony alignment, as in a dislocation or fracture; (b) to secure immobilisation of an inflamed joint; (c) to correct deformity.

Principles of traction. "Two strong men will suffice by making extension and counter-extension." (Hippocrates 350 B.C.) "For every action there is an equal and opposite reaction." (Newton's third law of motion.)

Traction on a limb requires a fixed point from which to work, or an equal counter-traction in the opposite direction.

Types of traction. (a) *Fixed traction* is traction between two fixed points. For example, in the Thomas bed splint traction is exerted by extension tapes tied to the end of the splint while counter-traction is supplied by the pressure of the

ring against the ischial tuberosity (Fig 1) Another example of fixed traction is that supplied by the Jones abduction frame in which the pull of skin extensions tied to extension bows is countered by the pressure of a groin strap (Fig 2)



Fig 1.

Fixed traction is supplied by the pull of extension tapes tied to the end of a Thomas bed splint countered by pressure of the ring against the ischial tuberosity (Watson J)

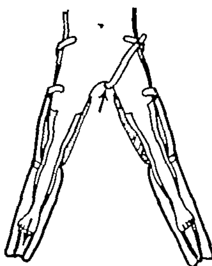


Fig 2.

In the abduction frame the pull of skin-extension tied to the bows of the frame is countered by the pressure of a groin strap. (Watson Jones)

(b) *Balanced traction* is traction exerted against a weight. For example extension tapes are tied to a cord which carries a weight running over a pulley fixed to the elevated foot end of the bed counter traction is provided by the patient s body weight (Fig 3)

(c) *Combined fixed and balanced traction* A Thomas bed splint is applied in the usual way and extension tapes tied (fixed traction) The splint is then fastened to the raised foot end of the bed, or traction is applied to it by a weight and pulley (balanced traction) In cases in which this type of traction is used, the splint may be suspended from an overhead beam This makes for easier nursing as the patient s body and splinted limb move about the bed as one unit

(d) *Sliding bed traction.* (Dunn Hendry bed) The mat

tress is placed on a wooden surface which slides on roller bearings over the bed itself The foot of the bed is elevated, and extension tapes are tied to its fixed part. (Fig. 4)

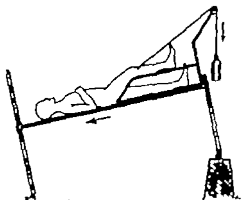


Fig 3
Balanced traction. (See text). (*Watson Jones*)

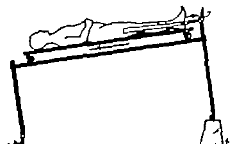


Fig 4
Sliding bed traction. (See text). (*Watson Jones*)

Methods of applying traction. (a) *Skin traction* In this, the traction force is applied to the skin from whence it is transmitted to the muscles and then to the bone Skin extensions are made from strapping either elastoplast extension strapping, Leslie's Holland strapping Taylor's perforated zinc-oxide strapping or Unna's paste (a mixture of zinc oxide glycerine gelatine and water)

(b) *Skeletal traction* In this, traction is applied directly to a bone a metal pin is driven through the bone and attached to a stirrup to which the traction is exerted by means of weights. The pin may be a Kirschner wire a Steinmann pin, or ice-tong calipers.

(c) *Pulp traction* A suture is placed through the pulp of a finger or toe and fastened to an extension piece incorporated in a plaster cast.

The optimum position for joints. The optimum position for a joint is considered to be that in which it is most useful to the patient should it become ankylosed, that is, stiff. An inflamed or injured joint is therefore splinted in this position and deliberately placed in it after the operation of arthrodesis.

Thus the shoulder is placed in about 70° of abduction, 30° of forward flexion and enough *external rotation* to allow the hand to reach the mouth when the elbow is flexed. The elbow is placed in a little more than right-angled flexion and the *forearm in mid rotation*, depending upon the patient's occupation and wishes. The wrist is held in about 30° of dorsiflexion and in the neutral position as regards radial and ulnar deviation. The fingers and thumb are considered to be in the optimum position when they are in the position adopted in grasping a tumbler. The hip is usually placed in extension, unless the lumbar spine or opposite hip is also stiff, when some degree of flexion may be of benefit to the patient. About 15 or 20° of abduction and external rotation is considered useful. The knee is placed in a position just short of full extension, and the ankle-joint is held so that the *foot is at a right-angle to the leg*. The joints of the foot are placed in the neutral position as regards inversion-eversion, abduction-adduction.

Whenever possible the normal physiological curves of the body are preserved, as for example in the spine and in the palmar and plantar arches.

Operative procedures. No attempt will be made to describe operations, and the student is referred to surgical text books.

MANAGEMENT OF ORTHOPAEDIC CASES

(1) Discipline. Although the rules, which make for efficient management and the well-being of all, must be carried out, discipline cannot be so strictly enforced as in a general ward. Long-stay patients must be permitted more latitude as to visitors, personal possessions, wireless sets and other amenities of life than those in general wards, though these things must never be permitted to distress those not in a condition to enjoy them. The atmosphere of an orthopaedic ward should be busy, pleasant and cheerful without being rowdy. Patients

are encouraged to take a lively interest in their surroundings, and an intelligent (but not morbid) interest in their conditions.

(2) **The nurse patient relationship.** Most orthopaedic cases are in hospital for many months, and this in itself calls for special qualities in the nurse her approach is, in the nature of things, more personal and friendly than is customary in a general ward. It should, however remain friendly not romantic, *and favouritism is to be avoided at all costs* The nurse may often be in a position to receive the patient s confidences, and she should report any cause for anxiety such as home or monetary difficulties, to the proper quarter

(3) **Orthopaedic wards.** In many hospitals these are either open or provided with verandahs. In tuberculous patients, open-air treatment is essential even in conditions in which it is not essential the improvement in the health and vigour of the patient is most noticeable One hospital sister with more than twenty years experience of nursing elderly women on an open air ward cannot recall one single instance of a common cold amongst her patients, much less bronchitis or hypostatic pneumonia These old ladies were protected from the cold by many shawls, bonnets, mittens, etc and many of them enjoyed better health than they had had for years The chief objection to open air wards seems to be the added labour of keeping the patients warm by the frequent refilling of hot water bottles and the adjustment of bedclothes.

There are two orthopaedic conditions which should not be nursed on an open-air ward, namely cases of poliomyelitis or spastic paralysis These cases should be nursed in a warm room.

Flooring The floor of an orthopaedic ward must not be polished

(4) **Beds.** Perambulator-wheeled beds are ideal as they facilitate moving the patient from place to place (*Fig* 5) In addition they give him an illusion of freedom and mobility Bedclothes must be suitable for the time of year and should be suitably arranged to accommodate splintage Though a ward full of beautifully made beds is a delight to the eye the patient s comfort must not be sacrificed to tidiness All orthopaedic beds are fitted with fracture-boards as a matter of course

(5) **Team work.** This is more important in this type of nursing than in any other branch as many orthopaedic nursing procedures cannot be undertaken by one nurse alone In large orthopaedic wards, bedpan rounds should be shared by the nursing staff Such an important nursing procedure should not be delegated to one solitary junior nurse



Fig 5.

A group of children at school in an open-air hospital. Note the wheeled beds.

(6) **Daily nursing care.** The practice (advocated by the late Dame Agnes Hunt at Oswestry) of holding one nurse personally responsible for a given number of patients has always been found most satisfactory particularly amongst long-stay cases. Nothing so stimulates a nurse s interest, or so fosters a sense of pride in her work, as *to feel that the patient s welfare* is her direct concern The nurse just commencing training can be given easily managed cases to start with, and graduate to more difficult ones as her skill and sense of responsibility increases. Whenever possible, she should be present when her patient is seen by the surgeon when he attends the operating theatre, plaster or X ray room. Every effort should be made to

instruct the nurse with regard to nursing procedures, even though it entails the expenditure of valuable time. Shortage of nursing staff often means that any out-of the-ordinary procedure is carried out by the person who can do it in the shortest time, that is, by the most senior nurse on the ward. This should be avoided whenever possible and each nurse is encouraged to carry out treatment on *her own patients*. Daily and thorough washing of patients wearing splints and plasters is essential, as to many of these total immersion in a bath may not be allowed for many months.

(7) **Tuberculous patients.** A special note is necessary with regard to these patients. Most of them have an enormous fund of courage and fortitude which helps them to bear cheerfully the rigours of prolonged treatment in hospital, but occasionally *they require special consideration and encouragement.* The nurse must adopt a hopeful attitude whilst avoiding airy optimism. These patients must thoroughly understand the necessity for efficient general treatment as well as local fixation so that their co-operation is assured. Occupational and diversional therapy is very valuable and amusements such as concerts and film-shows must be provided. Tuberculous patients are sexually alert and may require encouragement in exercising self-discipline and self-control.

(8) **Preparation of patients for examination.** When preparing patients for examination by the surgeon the following points should be observed :—

1. The part of the body to be examined must be completely exposed; in the case of the limbs, *both* limbs are exposed so that they can be compared.

2. Any splint or appliance worn by the patient is presented for inspection.

3. Case notes and X-rays are placed near at hand, but not where they can be read by the patient.

The following notes may be found helpful in preparing patients for examination of particular regions of the body :—

The spine. The patient is completely unclothed except for a garment known as a "splash". This consists of a short strip of cotton material which is placed between the legs and

fastened over the pelvis by means of tapes, as shown in Figs. 74 and 162. A dressing gown is then put on and the patient made comfortable on a couch and covered with blankets. He is usually examined first in the lying position and in suitable cases may be asked to stand and walk. The following articles should be held in readiness :—

A tray for neurological examination containing a tendon hammer, a pin, a wisp of cotton wool and test tubes for hot and cold water. A tray set for rectal or vaginal examination may also be required. A tape-measure, skin pencil, plumb-line and raising blocks should also be held in readiness.

The hip. The patient is unclothed except for a splash and dressing-gown, and is examined lying. Suitable cases are asked to stand and walk. A tape-measure, skin pencil, raising blocks and an angle-measure may be required.

The knee. As both knees must be exposed male patients are asked to remove their trousers, and to wear a splash. Both shoes and stockings are removed; the patient is examined lying and may be asked to stand and walk. An angle measure may be required.

The feet. Both shoes and stockings are removed, and the patient may be examined sitting, standing and walking. *The shoes* are presented for the surgeon's inspection; they should not be new ones, and the patient may be asked to bring those which he habitually wears.

The shoulder. The patient is examined sitting. In male patients, the shirt and undervest are removed. In females, the blouse or dress is removed and the undergarments pinned around the trunk below the axillae. A dressing gown or blanket is then placed around the shoulders. An angle measure may be required.

The elbow. The sleeves are rolled up well above both elbows. A dress or shirt with tight sleeves should be removed. An angle-measure is often required.

The wrist and hand. The sleeves are rolled up to the elbow. Wrist watches or other articles of jewellery should be removed. An angle-measure may be required.

In cases of injury to the wrist hand or fingers in which swelling of the extremities is expected (as for example in a Colles fracture) any rings worn by the patient should be removed forthwith if necessary by means of a ring-cutter Failure to remove a ring may result in gangrene of a finger

CHAPTER III

PHYSIOTHERAPY IN RELATION TO ORTHOPAEDICS

The purpose of exercises. Types of exercise. Dangers of passive stretching. Exercise classes. Home exercises. Postural exercises. The use of apparatus. Other forms of physiotherapeutic treatment. Re-education in walking. The use of crutches. Walking with sticks. Walking in a caliper. Fitting in splintage which fixes the hip.

IT has already been stated that physiotherapy is in many cases an integral part of the treatment of orthopaedic conditions. To the nurse such terms as "re-education in walking" or "flat foot exercises" may be merely catch words and the following short notes on the work of the physiotherapist may be found helpful.

It is essential that the physiotherapist engaged in orthopaedic work is herself a trained orthopaedic nurse. This training is the only means by which she can acquire not only a true understanding of the patient's needs, but a correct attitude of mind. This attitude of mind enables her to approach the patient in such a way that he is encouraged to work out his own salvation in the improvement or restoration of function. He must cure himself that is the essential doctrine of physiotherapy (F. J. Cotton.)

The physiotherapist who is also an orthopaedic nurse has other important spheres of activity, notably in Plaster rooms and in After-care Clinics. In the latter her qualifications are essential, because many patients who attend these clinics are ordered exercises. It is no more the prerogative of the general trained nurse to give exercises than it is the prerogative of the physiotherapist to nurse an acute abdominal condition—neither has the basic knowledge necessary for the work of the other.

Exercises. Broadly speaking exercises are ordered for the following purposes. (a) *To retain movements* in joints and normal tone in the muscles controlling them, so that stiffness is prevented, as for example in patients who are confined to bed

for long periods. (b) *To restore movements* which have been lost owing to disuse, injury or disease of joints. (c) *To re develop muscles* after disuse, disease or injury so that joint movement is controlled. (d) *To restore muscle balance* as in poliomyelitis or spastic paralysis.

Types of exercise. Exercises are classified according to whether the movements performed are active, assisted, resisted or passive movements.

An active movement is one performed by the patient himself.

An assisted movement is an active movement performed by the patient but assisted by the physiotherapist or by some mechanical device.

A resisted movement is one performed against resistance which may be supplied by the force of gravity, the physiotherapist, or by a mechanical device such as a weight attached to the limb.

A passive movement is performed not by the patient himself but by the physiotherapist. Passive movements are given only in those cases in which it is necessary to *retain movements* in joints, as in poliomyelitis or some other nerve lesion. In such conditions, the joints are normal, but cannot be actively moved because the muscles are paralysed. Movement must therefore be retained so that when recovery of the muscles takes place their function is not hindered by stiffness of the joints. In giving these movements, the physiotherapist holds the limb and carries the joint through its full range of movement without overstretching it in any one direction.

Passive stretching to joints which are stiff from disuse, disease, or injury is absolutely forbidden. Passive stretching will produce a reaction in the joint manifested by pain and swelling and the formation of further adhesions, so that instead of movement being recovered, stiffness will actually increase and become permanent. The only person qualified to manipulate a stiff joint is the surgeon. A manipulation is followed at once by active exercises, *not by passive stretching*. Further reference to the dangers of passive stretching will be found in Chaps. XXIV and XXX.

Exercise classes. When possible, exercises are given in

classes the patient feels that there are others in the same boat as himself the competitive spirit is encouraging and boredom is avoided. Exercises are often performed to music and games are used as well as formal exercises, especially in children

Cases which require careful re-education of muscles or groups of muscles are treated individually though they may graduate to classes during later treatment for exercises of a general nature

Home exercises. These should be simple and fool proof It is better for the patient to perform three exercises correctly than a dozen incorrectly The patient is also instructed in such active use as is fitted to his condition for example a patient with a wrist immobilised in plaster for a Colles fracture should carry out any light work which does not involve wetting the plaster

Postural exercises. These are exercises which are given to restore the poise and balance of the whole body Special emphasis is placed on re-education of the erector spinae the abdominal and gluteal muscles and the quadriceps. Though postural exercises are used in particular for correction of postural defects, they are often in fact part and parcel of the physiotherapeutic treatment of many varied conditions, because a patient must be treated as a whole and not merely as "a knee or "a hip"

Exercises of this nature are given in a "table" that is, they are arranged in an orderly manner so that different groups of muscles are exercised in turn. Simple, easily performed movements are given at first and gradually progressed as muscle power and co-ordination improves. Breathing exercises are very important and re-education in correct heel and toe walking is an essential part of the treatment.

The use of apparatus. Many appliances have been devised as aids to physiotherapy The ones in general use include walking machines, stationary bicycles and rowing machines, and various elaborate arrangements of slings and pulleys. Though this equipment is desirable it is by no means essential. The only *essential* equipment for successful treatment is the knowledge and enthusiasm of the physiotherapist and the co-operation of the patient.

Other forms of physiotherapeutic treatment. *Massage* is not often ordered in orthopaedic practice though it is useful in improving circulation and is enjoyed by the patient.

Electrotherapy Faradism is used to produce muscle contraction by stimulation of the nerve endings. Galvanism also produces muscle contraction by stimulation of the muscle fibres themselves. Other forms of electrotherapy such as diathermy may be ordered, but a description of such treatment is outside the scope of this book.

Radiant heat is frequently ordered for the relief of pain and the improvement of local circulation.

Heliotherapy Artificial sunlight is ordered in the absence of natural sunlight in cases of rickets or of general debility. Local artificial sunlight may be ordered in the treatment of wounds.

Hydrotherapy (exercises in water) is valuable for such conditions as poliomyelitis.

Re-education in walking is ordered when this function has been interfered with by disease, injury or deformity of any part of the body. In all cases, it is essential that the patient is taught to *stand* unassisted before actual walking is attempted, especially if he has been bedridden for a long period. When balance is assured, the following instructions are given (1) The body weight must be taken equally on both legs. (2) Steps must be short and of equal length. (3) The toes must point straight forward. (4) The heel strikes the ground first at the moment weight is taken on the foot which is in front the *knee is pressed back* by the action of the quadriceps, and the patient rises on the toes of the foot which is behind. (5) The knee on that side is then flexed to "follow through the step, but it must be *straight at the moment af... takes the body...* The patient must practise th... nd toe" exerci... ow motion" until it becomes ...al manner of w... tension of the knee must ... upon at every ... i... ally after knee injuries.

... of crutch ... must be at ... h,
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be comfortably padded and a careful watch is kept for crutch palsy. If it occurs, the crutches are temporarily discarded. In children the crutches must not become outgrown.

Elbow crutches are sometimes used, especially in cases in which they are required permanently.

Walking on crutches. A patient who is able to move each leg separately is given the following instructions. (1) He stands on the crutches, leaning a little forward with the crutches about a foot in front of him. It is best to commence by standing for increasing periods each day before actual walking commences, encouraging the patient to look round the room meantime. Next, he should lift first one leg then the other from the floor several times without actually taking a step forward. (2) When the patient is confident of his balance instruct him to place the right crutch forward, then the left foot; the left crutch follows, and finally the right foot. One crutch is always kept forward to prevent the patient from falling. The crutches and the feet must be placed forward in short steps of equal length.

Tripod walking is employed in patients with extensive paralysis of the legs and trunk. The crutches are placed well forward and out to the sides, and the patient leans forward between them, so that the crutches form two arms of a tripod and the body a third. (Fig. 167.) When balance is assured, first the right and then the left crutch is placed a short distance forward and the legs are drawn towards them as one unit.

Walking with sticks is ordered in patients who are not so disabled as to require crutches but who need support. *One stick is not permitted; the patient requires either two sticks or no stick at all.* They are used in the same manner as crutches, placing the right stick forward, the left foot following, then the left stick and the right foot.

Walking in a caliper. If the caliper is "long", that is, weight relieving, the patient is tempted to clear the ground by swinging the caliper out sideways; this must not be allowed. The patient is first taught to stand in the caliper; do not allow him to progress by clutching at the wall or the furniture; start off with the feet together and about six or eight inches apart so that the bodyweight is evenly distributed over a wide base. In

Other forms of physiotherapeutic treatment. *Massage* is not often ordered in orthopaedic practice though it is useful in improving circulation and is enjoyed by the patient

Electrotherapy Faradism is used to produce muscle contraction by stimulation of the nerve endings. Galvanism also produces muscle contraction by stimulation of the muscle fibres themselves. Other forms of electrotherapy such as diathermy may be ordered, but a description of such treatment is outside the scope of this book.

Radiant heat is frequently ordered for the relief of pain and the improvement of local circulation.

Heliotherapy Artificial sunlight is ordered in the absence of natural sunlight in cases of rickets or of general debility. Local artificial sunlight may be ordered in the treatment of wounds.

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The use of crutches. Crutches must be of such length and the hand-rest so placed as to allow the weight to be taken on the hands and not in the axillae Axillary crutches should

PLASTER OF PARIS TECHNIQUE

Preparation of plaster bandages. Plaster slabs. Requirements for application of plaster. Method of soaking a plaster bandage. Application of a plaster cast. Nursing care immediately after application of plaster. Daily nursing care of patient wearing plaster. Indication of a plaster sore. Treatment of plaster sores. Application and care of special plasters. Plaster jackets. Hip spicas. Nursing care of patient in plaster jacket and spica. Instructions to outpatient wearing plaster. Removal of plaster. Plaster beds. Turning cases. Plaster shell. Split casts. Record card.

PLASTER of paris consists of calcium sulphate which is obtained from gypsum and rendered anhydrous by calcination; when mixed with water it swells and sets rapidly to form a hard cement.

Plaster bandages are made by rubbing prepared plaster in to strips of crinoline. A proprietary brand such as "Gypsona" may be used, especially for small light casts for the hand or fingers. Home made bandages are cheaper and more durable, and are used for weight bearing casts.

Preparation of plaster bandages. *Requirements.*—

(1) *Crinoline* is supplied in packets, but time and labour is saved by the use of "Plaserin" which is sold in rolls 4 yds. × 2 ins., [illegible] ins., 6 ins., or 7 ins. If this is not used, the crinoline is torn (not cut) into strips of the required length and width. Each bandage must be torn separately about ½ ins. wider than the width required. Remove seven threads from each side, otherwise these will become *detached* when the bandage is used and form strands which may cause pressure sores and/or interference with circulation.

(2) *Fine Italian dental plaster.* This must be stored in a dry place, and will not keep for longer than about three months. Stale plaster will not soak or set properly and crumbles in use.

Method. Place a mound of plaster on a smooth topped table; the plaster must be free from lumps. Unroll a short

struct the patient to *lift* the caliper forward, not swing it, to take a short step and to bring the sound leg forward beside it As confidence increases, the sound leg passes the splinted one in a short but even and normal step

Method of negotiating steps. To go upstairs, the sound foot is placed on the step above and the splinted foot is then lifted on to the same step To go downstairs, the splinted foot is placed on the step below then the sound one. The same instructions apply in any case in which splintage fixes the knee and/or the hip

Sitting in splintage which fixes the hip. A high hard upright chair is generally preferred to an arm-chair The patient stands with his back to the chair a little in front and to the side of the affected hip he flexes the sound knee and lowers the buttock of the unaffected side on to the seat. Patients in splintage which fixes the hip and/or the knee can go to the cinema if they occupy the end seat of a row so that the splinted limb projects into the centre aisle

Permanent stiffness of the hip does not prevent the patient from leading a normal life. In one instance arthrodesis of the hip has not prevented a young woman from training as a nurse; another patient with permanent stiffness of *both* hips is able to climb trees. In young subjects, the lumbar spine develops such a wide range of movement that stiffness of the hip passes almost unnoticed.

Stiffness of the knee is not more disabling but it is more noticeable as the limb sticks out for example when travelling in public vehicles. This however does not prevent the patient from following normal pursuits.

a bandage makes a frail cast too little a bulky and expensive one The bandages are then laid flat in biscuit tins marked with the different sizes. Always handle the bandages and tins carefully or the plaster will be shaken out of the meshes of the crinoline

Plaster slabs are made in two ways —

(1) *Dry slabs* are prepared beforehand Instead of rolling the crinoline when the plaster is smoothed in fold it backwards

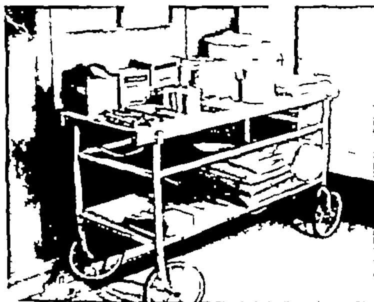


Fig 6.
Trolley set for application of plaster

and forwards on itself until it forms a slab of not less than six layers (Fig 7) Slabs are generally prepared in sizes 18 ins. × 4 ins 24 ins. × 5 ins. and 28 ins. × 7 ins. The completed slab is folded ends to middle and stored in the same manner as a bandage

(2) *Wet slabs* are made as required and applied at once A plaster bandage is soaked then folded over and over on itself on a glass or enamelled surface and applied to the limb.

Requirements for application of plaster

(1) *Bandages and slabs* of the correct size

strip of the crinoline bandage cover it with plaster and smooth it in until all the meshes are filled The bandage is lightly



Fig 6.
Preparing plaster bandages. (*Watson Jones*)



Fig 7
Preparing plaster slabs (*Watson Jones*)

rolled as it becomes impregnated with plaster (Fig 6) If it is rolled too tightly it will not soak if rolled too loosely the middle falls out when the bandage is used Only experience can teach the amount of plaster necessary too much plaster in

a bandage makes a frail cast, too little a bulky and expensive one. The bandages are then laid flat in biscuit tins marked with the different sizes. Always handle the bandages and tins carefully, or the plaster will be shaken out of the meshes of the crinoline.

Plaster slabs are made in two ways —

(1) *Dry slabs* are prepared beforehand. Instead of rolling the crinoline when the plaster is smoothed in, fold it backward

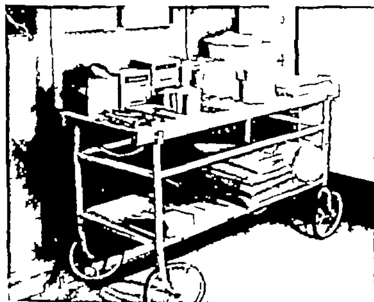


Fig. 8.
Trolley set for application of plaster

and forwards on itself until it forms a slab of not less than six layers. (Fig. 7.) Slabs are generally prepared in sizes ? ins. × 4 ins., 24 ins. × ? ins. and ?8 ins. × 7 ins. The completed slab is folded, ends to middle, and stored in the same manner as a bandage.

(2) *Wet slabs* are made as required and applied at once. Plaster bandage is soaked, then folded over and over on itself on a glass or enamelled surface and applied to the limb.

Requirements for application of plaster:

(1) *Bandages and slabs* of the correct size.

that it is not liable to slip It must be very sharp Linoleum or cobblers knives are satisfactory it is dangerous to use discarded scalpels.

(6) *Any special apparatus* such as an orthopaedic table hip-prop or head-suspension apparatus, should be placed in readiness.

To soak a plaster bandage Drop the bandage into the water and *leave undisturbed until the bubbles cease to rise* Do not attempt to hurry it by squeezing it in the water Grasp the bandage at each end, and squeeze gently towards the middle do not shake it or wring it free the end and hand it to the operator As the bandage is lifted from the bucket a fresh one replaces it lifted with a *dry hand* or small lumps will collect on the bandage *Do not splash* the bandages which are put out ready for use a splashed bandage will contain hard lumps which will cause pressure sores.

Application of a plaster cast

In suitable cases, vesting or padding is applied beforehand otherwise it is applied when the patient has been placed in position *The surgeon will hold the limb in the correct position throughout the procedure while the nurse applies the plaster* It is most essential that the correct position is maintained continuously A plaster cast will not benefit a patient unless it is correctly applied in a correct position. **Never attempt to correct position by pulling on a plaster bandage or by changing the position of the limb when the plaster is partly applied.** Such attempts will be met only by disaster Creases or ridges will form at the point where the bandage is pulled or where movement takes place and pressure sores and/or interference with circulation are certain to occur Routine changes of plaster are frequently delegated to the nursing staff, when a responsible person will hold the limb while the cast is applied.

To apply a plaster bandage. The bandage is *rolled* round the limb and contact between it and the part to which it is being applied must always be maintained. *Do not pull the bandage away from the limb* or the edge may form a tight strand. When changing direction so as to follow the contour of the limb, take a tuck at the upper or lower edge of the bandage

Always cover two-thirds of the previous turn, and smooth the plaster continuously with the free hand. A cast which is perfectly smooth is not likely to cause pressure sores, and the smoothing will cause each layer of plaster to adhere to the previous one. Air spaces weaken a plaster and indeed, a complete cast should not be a series of layers, but one homogeneous mass.

Slabs. These are applied wet and sloppy. In limb casts it is usual to commence application with a smoothly moulded slab; otherwise they are applied at strategic points where added strength is required, *for example* behind and in front of the hip-joint in a hip spica. Cover the slab at once with a bandage *otherwise it will not merge into the rest of the cast.*

Moulding. The plaster is very carefuly moulded over bony prominences, using the thenar and hypothenar eminences of the hand rather than the fingers. Speed is essential when applying plasters, but the comfort of the patient is the first consideration. It is wicked to apply a plaster roughly and then polish the outside. *The patient feels the inside.* Aim for neatness and smoothness first and speed will come with practice. Only experience can teach the number of bandages required for a particular cast: it should be as light as possible: a heavy plaster is not necessarily an efficient one.

Trimming. The edges of the cast are trimmed with a sharp knife. Edges should be smooth and rounded. Sharply angled edges—for example at the groin in a *hip-spica*—make the plaster more liable to crack. *If stockinette is used* it can be turned over the edges and secured either with a *strip of Gypsona*, or with flour paste. Alternatively it can be secured with strapping when the plaster is dry.

Nursing care immediately after application of plaster

(1) **Handling.** A wet plaster must be handled with the greatest care. *The cast must be supported in its entirety*: for instance never lift a hip-spica by the leg only or it will be certain to crack at the hip or the knee. Do not dig the fingers into a wet plaster: *use the thenar and hypothenar eminences of a relaxed hand.* Do not attempt to move the patient until the plaster has set. Plasters set more slowly in a hot

humid atmosphere or if applied over a great deal of padding. Before the patient returns to the ward excess plaster is cleaned from the skin with warm water using no soap.

(2) **Drying**. The appearance of a plaster sore is always blamed on the plaster room staff. Though it may indeed be the result of a badly applied plaster, it may also be due to mismanagement during the drying period. A fracture board is placed beneath the mattress to prevent sagging of the plaster. The patient is received on to pillows, arranged so that whilst the plaster is supported in its entirety, bony prominences such as the heels, the sacrum or the iliac spines are not receiving direct pressure (Fig. 10). *In no circumstances must these prominences rest on a hard surface.* When possible patients in jackets and spicas should commence the drying period lying on the face. Drying of plasters is best done in the open air, otherwise in a warm room; a room with a coal fire is ideal. *A wet plaster must not be covered*; it dries by the evaporation of moisture and covering the plaster delays the process. Areas not enclosed in plaster can be covered with a shawl or a strip of blanket. A newly applied plaster feels very hot and later becomes intensely cold. A dry plaster is the same temperature as the patient's body and is resonant on percussion. Hot water bottles may be arranged round a cast; they must be covered, and *must not touch the cast or a severe burn may result, especially in an unconscious patient*. It is doubtful whether they are of any real use other than for keeping the patient warm, because they dry the plaster only in patches and predispose it to cracking. A plaster cast should be dried as it is applied, that is, as one homogeneous mass. *Heat-cradles* are not used unless rapid drying is a dire necessity, because casts dried in this manner are very brittle. Great care must be taken to prevent burns; the patient must not be left unattended whilst under the heat-cradle.

(3) **Turning**. Patients in large casts such as jackets and spicas should be turned four or six hourly to ensure even drying. Two nurses are required to turn a patient in a spica and more may be needed. Lift the patient to the side of the leg which is enclosed in plaster and roll him over on the free one. If turned on to the enclosed leg, the spica will crack

A double spica must be turned in the air. Sitting cases—for example, shoulder spicas—can sit in a warm room. All plasters should be allowed a minimum of forty-eight hours to dry and large casts may require a longer period. Walking in a newly applied leg plaster is not permitted for at least forty-eight hours, and in large casts it is better to defer weight bearing for three days.

(4) **Inspection of the extremities is essential especially after operations or recent injuries.** Note the temperature and colour of the fingers or toes, whether there is pallor, cyanosis,



Fig. 10.
Double hip spica supported on pillows.

swelling or loss of movement. *Report any of these findings at once.* The fingers or toes must be *warm* and *rosy* and must flush quickly with blood on release of digital pressure. If there is any doubt as to the circulation, it may be necessary to split the plaster: this must be done *from top to bottom* down one or both sides, *the plaster and any padding beneath it is divided down to the skin.* Alternatively the cast is bivalved and the top half removed. Some surgeons insist that casts applied post-operatively are split before the patient leaves the theatre.

Daily nursing care of patients wearing plaster

Examine the patient himself: note the general appearance, question him as to his comfort. *Never ignore a complaint*

even if the patient seems unduly fussy. Be certain that full movement of joints not immobilised is being preserved. If ambulant note the gait. Be on guard against deformity of other parts.

Examine the plaster for cracks or limpness: report these at once. A cracked or limp plaster is not functioning as a splint. A metal back splint may be bandaged on to a cracked plaster as a temporary measure. The cast is then either renewed or repaired with a plaster slab and bandage. Ambulant patients must be kept in bed pending repair or renewal of broken plasters.

Plaster sores. These occur from the following causes:—

(a) *Pressure* due to carelessness in moulding, handling or drying, or to insufficient protection of bony prominences. Sores at the edge of a plaster may be due to roughness or tightness.

(b) *Friction*, as when a loose plaster rubs against a bony prominence.

(c) *Foreign bodies* inside the plaster, such as crumbs, beads or coins.

(d) *Delay in repairing cracks*, so that the rough edges chafe the skin.

Indications of a plaster sore include the following:—

(1) Itching beneath the plaster.

(2) A burning pain: this is characteristic and must on no account be ignored. If pressure continues, the tissues become anaesthetic and the pain disappears, because a deep sore has developed. It should be remembered that a loose plaster is as likely to cause sores as one which is too tight.

(3) Rise of temperature.

(4) Disturbed sleep: the night nurse must report restlessness or night-cries.

(5) Fretfulness, especially in children.

(6) An area of local heat on the plaster.

(7) Swelling of the fingers or toes, once reactionary swelling has subsided.

(8) An offensive smell.

(9) The appearance of a discharge.

Treatment of plaster sores. Cut a window over the sore and apply sterile dressings. Sloughing wounds require a moist dressing until the sloughs separate, then a dry dressing which is changed once weekly. The window is then packed with felt or wool, and the piece of plaster which has been removed is re-applied and secured with adhesive tape or a plaster bandage. This is to prevent swelling through the window. A sore due to the edge of a plaster should not be treated by cutting the offending edge horizontally. This will only produce another sore higher up. Split the edge longitudinally and insert a piece of adhesive felt, sticky side towards the plaster. Bind firmly with adhesive tape; this will relieve the pressure.

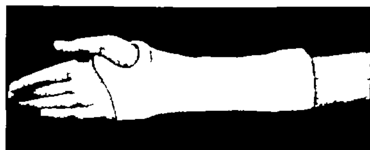


Fig. 11
Wrist plaster

Dermatitis occasionally occurs during plaster fixation in patients whose skins are delicate. Treatment consists of talcum powder blown through a window in the plaster.

Blisters may appear over an unprotected area after an injury. Treatment consists of aspiration of the blisters and the application of talcum powder.

Notes on the application and care of special plasters

Wrist plasters extend from the head of the radius to the knuckles. If they are carried only half way up the hand the fingers will swell. Unless otherwise ordered the plaster extends only to the transverse creases in the palm so as to allow full flexion of the metacarpo-phalangeal joint and approximation of the thumb and little finger. (Fig. 11.)

Above elbow plasters extend from just below the axilla to

the knuckles, and unless otherwise ordered are supported in a sling or collar-and-cuff (Fig 12.)

Shoulder spicas. Unless the patient is under anaesthesia a shoulder spica can be applied as he sits on a stool. Otherwise it is applied on a shoulder prop (Fig 13) alternatively the patient lies on a thin narrow plank of smooth polished wood which is placed so that it projects over the end of a table The plank is then pulled out at the bottom of the completed spica

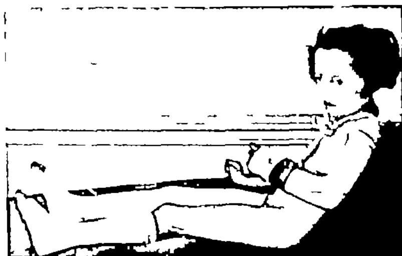


Fig 1_

Left arm—above elbow plaster supported by a collar and cuff Right leg—above knee plaster Left leg—below knee plaster Note that in this photograph the feet appear to be held in equinus. This is a great mistake Unless otherwise ordered the foot is always held at right angle to the leg

In heavy patients, it may be necessary to incorporate a strip of aluminium in the axilla this is better than making a supporting strut which prevents the patient from wearing normal clothing. The internal epicondyle of the humerus may require protection by a felt ring Where possible, drying is best commenced with the patient in the sitting position.

Knee guarding plasters extend from the groin to just above the malleoli. It may be necessary to apply elastoplast beneath the plaster from the toes to mid-calf in order to prevent swelling of the foot otherwise a ring of felt is placed beneath the

lower edge of the plaster to prevent it from slipping down the leg. *The plaster may be applied skin tight or over stockinette* and the head of the fibula may require protection. Unless otherwise ordered the knee is held a few degrees short of full extension.

Above-knee plasters extend from the groin to the web of the toes. The plaster is carefully moulded round the knee, the malleoli and the arches of the foot and must not prevent full flexion of the metatarso-phalangeal joints.

Below-knee plasters are trimmed sufficiently at the top to

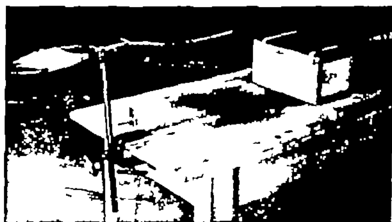


Fig. 13.

A shoulder prop. The pelvis rests on the box; when the shoulder spica is completed the box is removed and the patient moved downwards *so that the prop slides from beneath the upper end of the spica.*

allow full flexion of the knee. The head of the fibula and the malleoli may require protection. For walking plasters, the sole is reinforced and a boot is worn. This may be any large old boot or one which is specially made. A walking iron may be ordered, but this produces an unnatural gait. A wooden rocker is used in some hospitals. In any event the patient must be taught correct walking. If such a plaster digs into the base of the toes, it usually means that the sole has softened and requires reinforcement. Cutting the plaster away on the dorsum of the foot will produce swelling of the foot and toes.

Plaster slippers are shaped as the name suggests. In some conditions, the toes are covered completely except for the tips.

Plaster jackets may be applied with the patient in one of the following positions —

Standing between two upright supports.



Fig 14.
Application of a plaster jacket in head suspension. The patient is suspended so that only the toes touch the floor

Sitting.

Suspended by *head traction*. (Fig 14)

Lying on a hip-prop or orthopaedic table

Suspended between two tables, or suspended by the heels (hyper-extension jacket for fracture of the spine)

Drying is preferably commenced either sitting or in the prone position.

A double layer of vesting may be placed beneath a plaster jacket, the upper one only being adherent to the jacket the vest nearest the skin can then be rubbed up and down the body as a scratcher Alternatively a strip of bandage is placed down the plaster next to the skin and is used for the

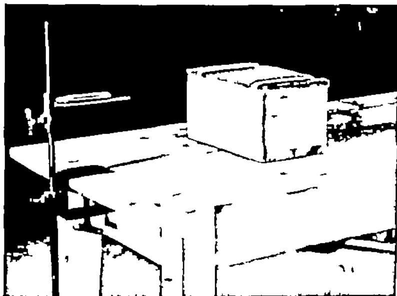


Fig 15.
A h p prop. The pel is is supported by the prop nd the shoulders rest on the box as shown in Fig. 16.

same purpose In general this i unnecessary and does more harm than good. In female patients, the brea t are either en closed completely in the plaster or left out altogether; in most cases the patient is more comfortable if they are enclosed.

Abdominal windows A window or blow hole may be cut over the abdomen in jackets and spicas this is not a routine procedure but is necessary in emphysematous patients or to relieve al dominal distention. Except in an emergency a window is not cut until the plaster is dry

Hip spicas are applied on an orthopaedic table or on a

hip prop screwed to an ordinary table (Fig 16) the shoulders are then supported on a box of suitable height The spica extends from the nipple line to either above or below the knee on the affected side the foot may or may not be included Double spicas enclose the sound leg to just above the knee and both legs may be joined by a strut The position of the limb will be decided by the surgeon. Unless otherwise ordered the hip is held in extension and neutral rotation. The degree of abduction depends upon the condition in the absence of specific orders, the limb is placed in the neutral position The knee

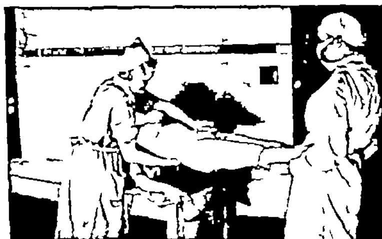


Fig 16.
Application of a plaster hip-spica. The hip prop, and the box which support the shoulders is shown in Fig 15.

is held in 5 or 10 flexion, and the foot if included, is held at a right angle and in neutral rotation. *The anterior superior iliac spine the inner border of the patella and the inner border of the great toe must be in the same straight line* The spica is trimmed at the groin sufficiently to allow for nursing It is trimmed round the buttocks at the level of the tip of the coccyx, and in a single spica enough is cut away in front to allow right-angled flexion of the sound hip

Nursing care of patients in plaster jackets and spicas

Patients in large heavy body casts require special care

(1) **Preparation.** If the patient has never been immobilised

before, he will be more comfortable if an enema or aperient is given so that the bowels are evacuated before the plaster is applied. This is advisable even in routine changes of large plasters, because an adequate bowel movement before the plaster is applied ensures that in most cases the patient need not be lifted on to a bedpan during the most important part of the drying period, i.e. the first twelve hours.

(2) **Position in bed.** When the plaster is first applied, the patient is received on to pillows as already described. In children the pillows are removed in forty-eight hours when the plaster is dry but adults generally prefer to retain them. They are arranged so that one or two support the lumbar spine one is placed beneath the shoulders one beneath the knees and as many beneath the head as the patient finds comfortable. In the case of a hip spica one or two pillows between the legs, one under the lumbar spine and two or three under the shoulders and head will enable the patient to lie on the side of the leg which is enclosed in plaster. *This manoeuvre is never attempted until the plaster is thoroughly dry.* Children, and such adults as can tolerate the position, should spend part of the day lying on the face. Helpless patients in heavy plasters must be turned from front to back or from side to side four hourly throughout the day and at night are fixed up in the position they find most comfortable.

(3) **Exercises.** *Movement in bed* is encouraged once the plaster is thoroughly dry exercises are given for joints not immobilised, and breathing exercises may be ordered in patients who show a tendency to develop chest complications.

(4) **The daily toilet** is carried out in much the same manner as that described for a patient on a frame (Chap. X.) except that the patient can be turned on to the side of the immobilised leg (in the case of a spica) for washing and attention to the buttocks. The edges of the plaster are kept clean, smooth and dry and talcum powder is dusted along all plaster edges and between all skin-folds. A pulley over the head of the bed enables the patient to lift himself for bedpans to be given. *Female patients must be taught to use a urinal.*

( ) **Complications.** If the patient is confined to bed, be on guard against the following complications :—

(a) Bronchitis, especially in the very young, the aged, the corpulent and the alcoholic

(b) Renal calculi from prolonged recumbency

(c) Abdominal conditions, such as acute dilatation of the stomach or paralytic ileus. Abdominal distention, pain, vomiting and constipation is a matter for concern and must be reported at once

Instructions to out patients wearing plaster

The patient is not allowed to leave the hospital or clinic unless it is certain that the circulation in the extremities is unimpeded. He is given the following instructions —

(1) The date of his next attendance at the hospital or clinic

(2) If there is swelling of the extremities, the patient may be instructed to remain recumbent with the limb elevated. Swelling of the extremities is not a contra indication to exercises; on the contrary, their performance is then imperative. Even if there is no swelling, the patient is instructed not to allow the limb to hang down whilst sitting about the house

(3) The fingers and toes are actively exercised at regular intervals, but never passively stretched; other joints not immobilised are also exercised. Patients in newly applied plasters generally attend the hospital or clinic daily for exercises until it is certain that full movement of all joints not immobilised is being preserved, and active use of the limb is encouraged.

(4) The patient should report to the hospital or clinic *at once* if the plaster cracks.

(5) He is told to report anything which may indicate a plaster sore

(6) The plaster must be kept dry

Removal of plaster

Requirements —Plaster shears, saws, openers, and mackintoshes or cotton covers to protect the clothing.

Procedure. A plaster cast is *bivalved*, that is, it is deliberately cut in half, not merely hacked off the body or limb. The patient lies comfortably on a table or couch of convenient height. Approach the patient quietly, especially if he is a child

Avoid noise fuss and flourishing of implements. Explain to the patient what is about to be done and reassure him. Place a mackintosh or cotton cover beneath the plaster. Mark in pencil the line you wish to follow. Insert the cutter blade beneath the plaster keeping it flat on the limb do not dig the point into the patient. With the cutters at a right angle to the plaster cut or nibble a millimetre at a time. Be deliberate. It is better to remove a plaster slowly than to cut the patient. *Exercise special care when passing over joints in young children in cases where there is loss of skin sensation and in patients under anaesthesia.* In foot plasters, cut behind the internal malleolus and in front of the external malleolus. This exerts the minimum of pressure on bony points. Large heavy casts may require to be sawn, rather than cut with the shears. When both sides of the plaster have been cut secure the plaster with strips of bandage tied round it at intervals. Then encase the whole cast in a firm bandage. A bivalved plaster may be retained as a splint. The surgeon may remove only the top half of the cast for inspection or the limb may be lifted out altogether after pressing out the sides of the cast with the openers. *Never remove a plaster altogether without permission from the surgeon.*

Plaster beds, turning cases, plaster shells, splint and record casts

Plaster beds. A plaster bed extends from the seventh cervical vertebra to the tip of the coccyx. From this level two leg pieces extend to just above the malleoli. A headpiece may be ordered. (Fig 89.) The patient lies prone with his arms to his sides and his scapulae level. Be sure the head is central the spine straight the hips in extension, neutral rotation and sufficient abduction to allow for nursing purposes. The knees are slightly flexed and the feet hang over the end of the table. If the feet require to be supported, separate plaster shells are made when the patient is lying on his back. Footpieces are never incorporated in a plaster bed not only is it practically impossible to make them in a correct position, but the patient levers himself up the plaster bed by pressing against them. Plaster beds are made by one of two methods.

Method 1 *Requirements* Three nurses, two large

buckets of sloppy plaster cream and several sheets of crinoline cut out to fit the patient's body and legs. Smear the patient's back and legs with vaseline or olive oil. Protect the hair. At the moment the plaster cream is prepared Nurse 1 soaks the sheets of crinoline in the cream and hands them to Nurses 2 and 3 who are standing at the head and foot of the table. They lay the sheets on the patient's back, spreading them out and moulding them carefully to the contours of the body, adding further sheets until the bed is of sufficient thickness.

Method 2. *Requirements.*—Two nurses, buckets of water, plaster bandages, and slabs. Smear the patient's back and legs with vaseline or olive oil, or lay a piece of crinoline over the body, splitting it up between the legs. The nurses stand on either side of the patient. Plaster bandages are soaked and rolled smoothly to and fro between the two nurses over the patient's back and legs. Plaster slabs are laid over the hip and knee joints for added strength. This method is simpler as it requires only two operators, and in an emergency can be accomplished single-handed.

Finishing the bed. Whichever method is chosen, the bed remains on the patient's body until it has set. A plaster bar unites the legs. The bed is marked and cut out opposite the tip of the coccyx for nursing purposes, and lifted off en masse. It is then trimmed, dried and lined, either with felt or with three layers of splint wool, and covered with stockinette secured with flour paste. A smoothly made bed should in fact require no padding at all. When finished it is mounted on wooden blocks made by the hospital carpenter (Fig. 89). In an emergency it may be supported on a straight frame from which the saddle has been removed.

To make a turning-case for use with a straight frame. Remove the clothing and the leg bandages, bend out the bars of the frame over a block. Protect the pubic hair with a th[illegible] piece of wool. Cover the trunk and legs with a sheet of cr[illegible]line and proceed as for making a plaster bed. When comp[illegible] wash the patient, replace the bars, bandages and el[illegible] a[illegible] leave the patient comfortable.

A turning case for use with a plaster bed is made [illegible] same way.

Plaster shells are used to support the limbs and to prevent deformity They are not suitable for *correction* of deformity a complete plaster is always necessary Plaster shells are best made directly on to the skin, or over stockinette only Wool *padding is not* used. *Start with a well moulded slab* and enclose the limb with bandages as if making a complete cast Mould the plaster very carefully over bony prominences. When set,



Fig 17
Taking a cast f block leather hip splint. (See text).

mark the edges of the shell, and cut out with a sharp knife When the shell is dry line it with splint wool covered with stockinette or with stockinette only and turn the edges over neatly The shell is either bandaged on to the limb, or canvas bands and buckles are incorporated in it

Plaster casts. Plaster casts are made of the body or part of the body for the following purposes —(1) so that a splint may be moulded to the exact contours of the body or limb, or (2) for record purposes.

To make a cast for a splint. *Requirements* —Vesting or



Fig. 18
The transverse lines are approximated and the cut edges bound together by a circular bandage



Fig. 19
The negative cast.

oil to protect the skin plaster bandages, buckets of water a sharp knife an indelible pencil.

Method The method of obtaining a cast for a block leather spica will be taken as an example At least two operators are necessary The patient is vested or oiled and placed on a hip-prop Padding is unnecessary the splint should fit like a



Fig 20.
Filling the negative cast. (See text).

second skin. Proceed as for applying a plaster spica *be certain that the first layer of the bandage is absolutely smooth any creases, ridges, or lumps will be reproduced in the splint* with disastrous results. The spica extends from the nipple line to above or below the knee When sufficient plaster has been applied (about three layers of bandage should be sufficient), mark the sides in transverse lines with an indelible pencil

The lines are approximated when the cast is cut to secure accurate apposition of the cut edges. When nearly set cut

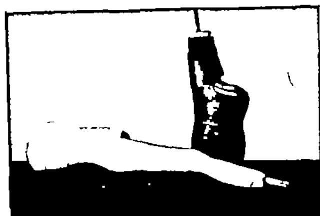


Fig 1
The positive cast. This illustration also shows a block leather hip-spica in process of construction. The leather is soaked and stretched tightly over the surface of the cast. Completed block leather hip spica are shown in Figs. 118 and 146.



Fig 22.
After oiling the limb, a piece of waxed thread is placed along the finger tips and up the sides of the forearm.

the cast down each side with a sharp knife (Fig 17) Remove it and while an assistant holds the edges together enclose the cast with a circular plaster bandage as shown in Fig 18 This is the negative cast. (Fig 19)

To make the positive cast. *Requirements.*—One or two operators, a piece of metal or wood, buckets of water, an enamel jug, vaseline or olive oil, and either dry white plaster or the cheaper "pink boiled" variety.

Method. Place the cast on a mackintosh with the leg piece upwards, and grease the inside. Insert the strip of metal or wood. This is to facilitate handling of the cast. Prepare a sufficient quantity of sloppy plaster cream, pour it rapidly down



Fig. 23.
Plaster cream is poured into and around the limb until it is completely surrounded.

the leg piece until the whole cast is filled. (Fig. 20.) When firmly set, cut away the negative cast. The positive cast is then smoothed over with a sharp knife, thoroughly dried, marked with the patient's name and sent to the splint maker. (Fig. 21.)

To make a record cast. *Requirements.*—A lead bath or tray covered by a mackintosh or piece of brown paper, olive oil for greasing, waxed thread, a bucket of water, plaster of paris, and two chisels.

Method. Oil the part from which the cast is to be taken and lay it on the tray; the limb must not touch the bottom of the tray. Lay a piece of waxed thread round the limb. In the case of a hand, the thread passes down the middle of the ulnar side of the forearm, along the outer side of the fifth finger

across the finger tips, and up the radial side of the hand and forearm, as shown in Fig 22

Prepare a bucket full of sloppy plaster cream and pour it on and around the limb until it is completely surrounded (Fig 23) Let it set but not harden. *Pull the waxed thread to separate* the cast into two halves insert two chisels under the

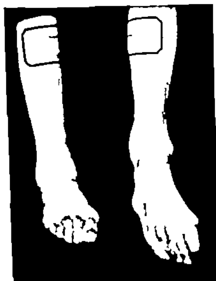


Fig 24.
Record casts. A case of paralytic equino varus deformity of the right foot, before and after treatment

crack and lift the top half off gently Remove the limb from the lower half and bind the two halves together with a plaster bandage. This is the negative cast Allow it to dry for several hours, then grease the inside with olive oil, and fill it with plaster cream, adding a hook at the top. When this has set, gently *chisel away the* outer or negative section of the cast Take care not to chip the cast When the negative has been removed dry the positive cast for about a week, polish it with french chalk, mark it with the patient s name and hang it up The nurse may be asked to make before and after treatment record casts of deformed hands or feet.

Chapter V

SPLINTS AND APPLIANCES

The uses of splints and appliances. Application of splints. Prevention of splint sores. Treatment of splint sores. Description, measurements, and uses of Thomas' straight frame and saddle. Jones' abduction frame and saddle. Thomas' hip splint. Jones' posterior spinal support. Thomas' collar. Torticollis collar. St. Vincent skeleton splint. Thomas' bed splint. Walking caliper. Bucket-top caliper. Jointed caliper. Thomas' patten-ended caliper. Knee cage. Knock-knee iron. Macdonald splint. Braun's splint. Double below-knee iron. Fixed iron. Contrary stops, posterior stops, anterior stops. Inside iron. Outside iron. T strap. Metal gutter-splints (back splint). Club-foot shoe. Crab-splint. Denis Browne's club-foot splint. Denis Browne boots. Thomas' arm splint. Thomas' platform abduction arm splint. Axillary wedge. Elbow cage. Cock-up splints. Moulded block leather splints. Shoe alterations. Type of shoe suitable for alteration. Insoles.

SPLINTS and appliances are usually made of metal or leather or a combination of both. They may also be made of celluloid or canvas supported by leather or metal, and plaster of paris is widely used (Chap. IV). The splints described in this book are capable of many variations, but the principles underlying their application and care remain the same. They are used for the following purposes:—

(a) To provide immobilisation.

(b) To provide fixed points from which traction may be exerted.

(c) To prevent or correct deformity.

(d) To relieve weight.

The principles of their application and care will now be described in broad outline. The management of particular splints will be described in subsequent chapters dealing with the conditions for which they are used.

Application of splints. Measurements must be accurate and in many cases a plaster cast of the part is required, especially if deformity is present. The measurements given in this book are not arbitrary and will vary with different splint makers. Co-operation between the nurse and the splint maker

is essential and it is the duty of the nurse to see that splintage carries out the function for which it is ordered. A splint must be a *perfect* fit: makeshift, uncomfortable and inadequate splintage should not be accepted.

Prevention of splint sores. These are regarded as a blot on the nurse's escutcheon, and occur from the following causes:—

(1) *An ill fitting splint.* One which is too small will cause sores from pressure: one which is too large will cause sores from friction.

(2) *Neglect of the skin or of the splint itself.*

Care of the skin. Three essential points must be observed:

(a) The *circulation* in areas subjected to pressure must be maintained.

(b) The skin must be kept scrupulously *clean*.

(c) It must be kept *dry*.

When the splint is first applied, the areas of skin beneath it which are subjected to pressure must be treated every four hours by rubbing with soap and water. Once the skin has hardened and become accustomed to pressure, treatment is carried out once or twice daily. The skin must be kept dry. Dampness is a contributory cause of pressure sores.

Large quantities of dusting powder should not be used, and spirit should never be used in conjunction with leather splints as it hardens and cracks them. Grease is not used except in the case of young children or incontinent patients.

Care of the splint. This is inspected daily for signs of wear and tear. Any necessary repairs are executed promptly. Avoid careless handling which may damage the splint. *Cleanliness of the splint is as important as cleanliness of the skin.* Leather splints should be cleaned and rubbed daily with saddle soap to keep them soft and smooth.

Treatment of a splint sore. If this calamity should occur, first consider the *cause* of the sore. Make every effort to remove it, whether it be a fault in fitting or cleanliness. The commonest cause is undoubtedly pressure, and this must be removed at all costs, the aim being to relieve local pressure by distributing it

over a larger area. It is therefore quite useless to place pieces of gauze or wool or other material over a sore or an impending one Rather place protective material on either side or all around the area Once the skin has broken the sore must be treated with sterile dressings, and the surrounding areas only treated with soap and water in the usual way

Importance of training the patient. Whenever possible the patient should be taught the management of his splintage before being discharged from the hospital He should understand the purpose for which it is worn so that his co-operation is assured.

Thomas' straight frame

This splint was originally designed by Hugh Owen Thomas as a means of transporting patients suffering from tuberculosis of the spine It is now used in that condition to provide rest —enforced, uninterrupted and prolonged (H O Thomas) and with proper management is a most comfortable and cleanly splint A description of such management will be found in Chap. X. The straight frame may also be used for any other inflammatory lesion of the spine e.g. osteomyelitis, very occasionally for extensive poliomyelitis (Chap. XXII), or for correction of spinal deformity from any cause notably adolescent kyphosis (Chap XX) and ankylosing spondylitis (Chap. XVIII)

The frame consists of two longitudinal metal bars which extend from the nipple line to the gluteal fold. The lowest 1 in. or 1½ ins. of the bars is bent backwards to accommodate the ischial tuberosity this is known as the ischial or gluteal bend (Fig 25) From this point two further longitudinal bars are joined at an angle of about 15 and support the legs to just above the ankle The lower longitudinal bars are joined by a cross-bar and are united to the knock-knee bars by crutches in which the ankles rest The nipple and the pelvic bars are made of malleable metal which can be moulded to fit the patient body and are riveted on as shown in Fig 26 The knock-knee bars are also made of malleable metal and can be bent to lie in the long axis of the legs. The legs are then bandaged to the knock-knee bars (Fig 92)

The headpiece is screwed on to the longitudinal bars and

may be *straight* or *sunken*. It consists of a metal framework encircling the head and covered with leather which presents either a flat surface (straight headpiece) (*Fig 25*) or one hollowed out to resemble an acorn-cup (sunken headpiece) (Fig 26)

Guards are made in the form of tubes of leather and cover the nipple and pelvic bars. A piece of bandage threaded

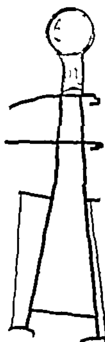




Fig 25. Fig 26.

Fig 25 shows Thomas straight frame with straight headpiece. Note the bend at the junction of the upper and lower longitudinal bars, this to accommodate the ischial tuberosity. Fig 26 is straight frame with sunken headpiece.

through two smaller guards is used to provide shoulder ties, as shown in Fig 92.

The saddle is made of high-quality leather and is firmly and evenly stuffed with lambswool. The patient's comfort depends very largely on the tension at which the saddle is stuffed. The portion supporting the trunk extends from the seventh cervical vertebra to the tip of the coccyx; the portions which

over a larger area. It is therefore quite useless to place pieces of gauze or wool or other material over a sore or an impending one. Rather place protective material on either side or all around the area. Once the skin has broken the sore must be treated with sterile dressings, and the surrounding areas only treated with soap and water in the usual way.

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The frame consists of two longitudinal metal bars which extend from the nipple line to the gluteal fold. The lowest 1 in. or 1½ ins. of the bars is bent backwards to accommodate the ischial tuberosity: this is known as the "ischial" or "gluteal" bend. (Fig. 25.) From this point two further longitudinal bars are joined at an angle of about 15° and support the legs to just above the ankle. The lower longitudinal bars are joined by a cross-bar and are united to the knock-knee bars by crutches in which the ankles rest. The nipple and the pelvic bars are made of malleable metal which can be moulded to fit the patient's body and are riveted on as shown in Fig. 26. The knock-knee bars are also made of malleable metal and can be bent to lie in the long axis of the legs. The legs are then bandaged to the knock-knee bars. (Fig. 92.)

The headpiece is screwed on to the longitudinal bars and

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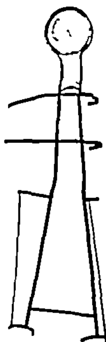




Fig. 25. Fig 26.

Fig 25 shows Thomas straight frame with straight headpiece Note the bend at the junction of the upper and lower longitudinal bars th t to accommodate the ischial tuberosity

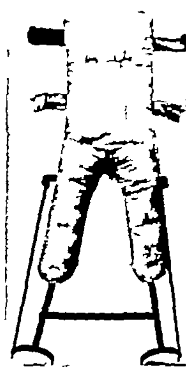
Fig 26 Straight frame with sunken headpiece

through two smaller guards is used to provide shoulder ties, as shown in Fig. 92.

The saddle is made of high-quality leather and is firmly and evenly stuffed with lambswool. The patient's comfort depends very largely *on the tension at which the saddle is stuffed.* The portion supporting the trunk extends from the seventh cervical vertebra to the tip of the coccyx the portions which

support the legs extend from the tip of the coccyx to just below the knee-joints. (Fig. 27.) It is attached to the frame by tapes threaded through the leather at the back of the saddle. (Fig. 28.)

Measurements for straight frame and saddle. (a) *The frame.* The patient lies on his back with his arms to his sides.



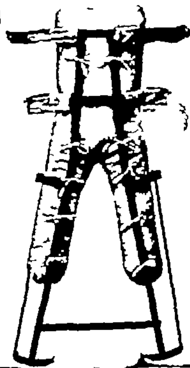


Fig. 27. Fig. 28.
Thomas straight frame without headpiece showing saddle and guards and also showing attachment of the saddle.

Mark the skin at the points from which measurements are taken. Measure :—

1. Nipple line to gluteal fold. (Place a tape measure in the gluteal fold and mark its lower border.)

2. From gluteal fold to 1½ ins. above the external malleolus.

3. Round the chest at the nipple line with the chest fully expanded, plus 1 2 ins. according to the size of the patient to allow for the thickness of the saddle

4 *Headpiece* Place a flat object such as a block or book against the top of the patient s head. Measure —(a) from the top of the head to the nipple line (b) the circumference of the head. State whether a straight or sunken headpiece is required

(b) *The saddle* The patient lies prone with his arms to his sides Measure —

1 From the seventh cervical vertebra to the tip of the coccyx.

2 From the tip of the coccyx to the head of the tibia

3 The width across the back between the tips of the scapulae This usually corresponds to one third of the chest measurement.

N.B An anterior plaster shell is used as a turning case in conjunction with a straight frame For method of making and description of use see Chaps. IV and X

Jones abduction frame

This splint is used in any condition in which traction and counter traction to the hip-joint is required, and has many ad vantages. It is an excellent method of maintaining traction whilst allowing the patient to be moved from place to place and it permits of free inspection of the part In common with the straight frame it is most comfortable and cleanly under proper management. A detailed description of its use in the treatment of tuberculous of the hip-joint will be found in Chap XI It may also be used for other inflammatory lesions of the hip for epiphyseal lesions, i.e. Perthe s disease or adolescent coxa vara (Chap XX) or for fracture of the femur (Chap XXVI) Occasionally it is used in cases of spastic paralysis to maintain abduction at the hip-joints. (Chap XXIII)

There are three types of abduction frames (a) single abduction frame (b) double abduction frame (c) double abducton frame with C-shaped cross-bar

Single abduction frame. The use of this type of frame is not advocated, for the following reasons —

(1) It allows of abduction of *one leg only* and in the vast

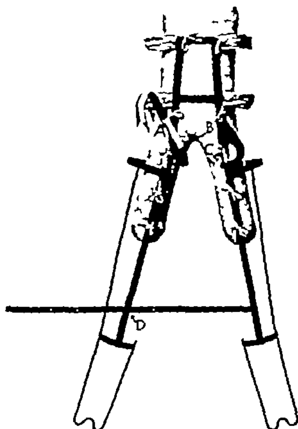


Fig. 29.

Jones double abduction frame. *The screws are removed* from the joints marked C and D; the degree of abduction is then adjusted at the joints marked A and B.

majority of cases, *both legs must be abducted equally* or deformity will result

(2) It is not economical, in that it can be used only for the side on which the leg can be abducted, whereas the double abduction frame can be used for either side

Double abduction frame. This presents two longitudinal bars, nipple bars, pelvic bars, and knock knee bars as in the straight frame The cross-bar is pierced by a series of holes and the lower longitudinal bars are jointed at their union with the upper ones, as shown in Fig 29 A further joint between the longitudinal and cross-bar permits of abduction of both legs to about 90 When adjusting the degree of abduction the screws are removed from the joints marked C and D in Fig 29 The lower bars can then be adjusted to the required degree of abduction at joints A and B The bars terminate in W shaped extension bows, to which skin extensions are fastened (Fig 134)

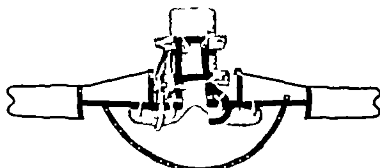


Fig 30
Posterior view of double adduction frame with C-shaped cross bar allowing abduction of both hips to 180

The guards are applied as described for a straight frame

The saddle is similar to that used with a straight frame except that the leg portions are more widely abducted

The groin strap is placed on the sound side to provide counter traction against the pull of skin extensions tied to the extension bows. It is made of boiler felt covered with leather and is fastened by means of eyelets to metal studs at the back and in front of the pelvic bar (Fig 135)

Measurements for a double abduction frame and saddle are exactly the same as for a straight frame *In addition* state whether 10 ins. or 12 ins. extension bows are required according to the size of the patient.

Double abduction frame with C-shaped cross-bar This is used for gradual reduction of a congenital dislocation of the hip (Chap. VI) and permits of abduction of both hips to 180 It is similar in construction to the double abduction frame, except that the C-shaped cross-bar is pierced with holes along its entire length and is movable at both ends, as shown in Fig 30


Fig 31.
Thomas hip splint.

Two saddles are required. One is made as for an ordinary double abduction frame and is used until 50 —60 abduction is reached. The second saddle is made with the legs abducted 180 (Fig. 30) See also Chap VI., Fig 64.

Measurements are exactly as for a double abduction frame and saddle.

Thomas' hip-splint

This splint is rarely used nowadays, though it is occasionally ordered in the late treatment of inflammatory lesions of the hip for example tuberculosis. (Chap XI) In construction it resembles one half of a straight frame i.e. having one longitudinal bar from nipple line to gluteal fold presenting a gluteal bend as in the straight frame, a further longitudinal bar terminating in an ankle-crutch nipple bars which are fastened in the same manner as in the straight frame and one pelvic bar Further semicircular bars support the leg half way down the thigh and just above the ankle. (Fig 31)

Measurements are as for a straight frame

Crutches are usually ordered.

Jones' posterior spinal support

This splint is often used in the late treatment of inflammatory disease of the spine. Details regarding its application and care in tuberculosis of the spine will be found in Chap. X. It is also used to take the place of weakened or paralysed spinal muscles, as in poliomyelitis (*Chap. XXII., Fig. 169*). More rarely it may be used in cases of spastic paralysis (Chap. XXIII.). It may be used in the treatment of spinal deformity from any cause, notably in ankylosing spondylitis (Chap. XVIII.) or adolescent kyphosis (Chap. XX.) or osteo-arthritis of the spine (Chap. XVI.).

The Jones spinal support consists of a frame-work of malleable tubular metal, which is padded with felt and covered with leather (Fig. 32.). Two shoulder straps pass under the axillae and buckle on to the support. A pelvic-band buckles on either side and two groin-straps prevent the support from riding upwards. A *webbing waist-band is also supplied.* A collar or abdominal belt may be added. (*Figs. 116* and 122.)



Fig. 32.
Jones' posterior spinal support

Measurements. The patient lies prone with his arms to his sides. *A plaster cast must be taken if deformity of the spine is present* (Chap. IX.). Measure —

1. From the seventh cervical vertebra to the tip of the coccyx, carrying the tape-measure over each small elevation and depression of the spine.

2. Round the chest at the nipple line.

3. Round the pelvis halfway between the iliac crest and great trochanter.

Thomas' collar

Thomas' collar is used in combination with a straight frame

or plaster bed to secure immobilisation in tuberculosis of the cervical or upper dorsal spine. (Chap X., Fig 108)

It may also be used with a spinal support in the late treatment of that condition. (Fig 116)

The collar is made of perforated leather and fastens at the back of the neck by means of a strap and buckle

Measurements.

1 Round the neck loosely



Fig 32A.
Thomas collar

2. From the chin to the supra-sternal notch with the head held in the desired position.

Torticollis collar

This is used in the correction of torticollis from any cause (Chap VI) It is similar in construction to a Thomas collar except that it presents an expanded portion on the side to which the head is laterally flexed, and a strap passes under the axilla of the opposite side (Fig 33.)

Measurements.

1 Round the neck loosely

2. From the angle of the jaw to the clavicle with the head held in the correct position.

State whether a right or left torticollis collar is required

St. Vincents skeleton splint

This is used in cases of scoliosis. It is constructed of tubular metal covered with leather a firm leather pad is strapped to the framework to support a rib hump as shown in Fig 7›

Measurements.

1 Round chest just below axillae



Fig 33a.
Right t rticollis collar

2. Round pelvis between iliac crest and great trochanter

3 Longitudinal measurement between points in these lines.

State whether a right or left splint is required.

Thomas bedsplint

Thomas bedsplint is widely used to provide immobilisation and traction in inflammatory lesions of the knee-joint for example tuberculosis. Details of its application and care in this condition will be found in Chap XII It is also widely used for fracture of the femur (Chap XXVI) to correct flexion contraction of the knee as in rheumatoid arthritis (Chap XVII) very occasionally for poliomyelitis affecting the quadriceps (Chap XXII) or for maintaining extension of the knee in spastic paralysis. (Chap XXIII)

bedsplint except that instead of terminating in extension bows, the parallel metal bars are fitted with prolongations which slot into a tubing placed in the heel of the boot (Fig. 35.) The knee is supported posteriorly by a leather sling and anteriorly by a knee-shield, which is attached to the ring by means of a strap. A heel strap prevents the lower prolongations from slipping out of the tubing and extension pieces allow of alteration in the length of the caliper. It is used for the following purposes :—

(1) To prevent direct weight-bearing on the lower limb.

(2) To maintain extension of the knee.

The essential difference in the application of the splint for either of these two purposes lies in its length. If the caliper is applied to relieve weight it must be of such a length as to allow the ring to be pressed firmly against the ischial tuberosity as shown in Fig. 35 whilst the under surface of the heel is clear of the inside of the boot : the limb is then suspended in the splint and the body weight is transmitted to the ground by means of the ring and parallel bars. This is known as the "long" or "weight-relieving" caliper and is used in the late treatment of tuberculosis or other inflammatory lesion of the knee-joint (Chap. XII), after fracture of the femur (Chap. XXVI.) or in any other condition in which it is necessary to prevent direct weight-bearing through the knee joint.

The "short" or "non-weight-relieving" caliper is ordered in cases of poliomyelitis affecting the quadriceps (Chap. XXII), in spastic paralysis (Chap. XXIII) or in any other condition in which it is desirable to protect the knee and hold it in extension whilst at the same time permitting weight bearing. It should be of such a length as to allow the ring to fit comfortably in the groin, and the under surface of the heel is in contact with the inside of the boot. (Fig. 36.)

Measurements.

1. Round the thigh at the level of the adductor tendon.

2. From the adductor tendon in the groin to the heel, with the foot held in right angled dorsiflexion.

If the caliper is to be weight relieving add ½-¾ ins. according to the size of the patient.

State whether a right or left caliper is required the boot is tubed in readiness.

Bucket top caliper

The construction of this splint is similar to that of an ordinary caliper except that a leather bucket encases the top of the limb instead of the ring The leather bucket has a turned-over lip posteriorly to support the ischial tuberosity (Fig 34) It is used for conditions already mentioned in connection with an ordinary caliper but this type is chosen for aged or obese patients in whom an ordinary caliper ring would be uncomfortable.

Measurements are as before In addition, a plaster cast is taken of the patient's thigh

Jointed caliper

This may be of the ordinary or bucket-top variety and presents a knee-joint which can be manipulated by the patient The degree of flexion allowed is decided by the surgeon. It is used in cases where a certain degree of movement with protection is desired, for example in poliomyelitis affecting the quadriceps (Chap XXII) or in cases of osteo-arthritis of the knee-joint (Chap XVI.)

Measurements are as already described. A paper tracing of the limb is essential, and in most cases a cast is necessary especially if deformity is present.

Thomas' patten-end caliper

This consists of a padded ring and longitudinal bars as in an ordinary caliper but the bars terminate in a circular plate covered with rubber on which weight is taken. (Fig. 34) A patten is applied to the boot on the sound side and the affected limb hangs free in the caliper A leather sling supports the back of the knee and a knee-shield is provided. In addition, a webbing strap fastens the caliper ring over the shoulder of the opposite side It is used in tuberculosis or other inflammatory condition of the ankle joint (Chap XIII) or after amputation of the lower limb.

Measurements.

1 Round the leg at mid thigh

2 From this point to the knee-joint.

3 From the knee joint to the heel.

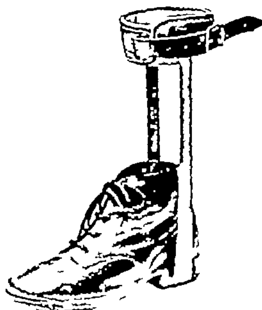


Fig 39.
Double iron fixed on the heel of the boot to prevent movement at the ankle-joint.

Braun's splint

This splint is used as a means of support in injuries to the lower limb, particularly where skeletal traction is employed It consists of a metal frame work shaped as shown in Fig. 38. A flannel bandage is placed across the upper bars of the splint to support the limb and a cord carrying weights runs over the pulley placed at the end of the splint (See Chap XXVI Fig 192)

Double below knee iron

This splint is used for the following purposes —

1. To prevent movement of the ankle joint whilst at the

same time permitting weight bearing, as in the late treatment of tuberculosis of the ankle joint (Chap XIII) *If all movement is to be prevented the iron is either fixed in the heel of the boot as shown in Fig 39 or the boot is fitted with contrary stops*, i.e. one behind the iron on one side of the boot and one in front of the iron on the other

2. To prevent plantar flexion of the ankle-joint beyond the right-angled position, as in poliomyelitis affecting the anterior

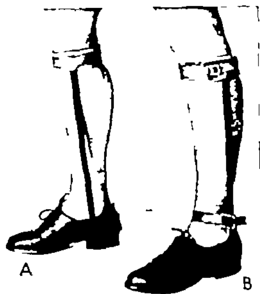


Fig 40.
A. Lateral view of double iron, drop foot stops.
B. Lateral view of outside iron, inside T-strap.
(See Fig 41.)

tibial muscles (Chap XXII.), in spastic paralysis (Chap XXIII) or in drop-foot deformity from any other cause. (Chap VIII) In these cases the stops are placed behind the iron. They are referred to as *posterior or drop-foot stops.* (Fig. 40)

3 To prevent dorsi flexion of the ankle-joint beyond the right-angled position, as in poliomyelitis affecting the calf muscles (Chap XXII) In this condition, the stops are placed in front of the iron—*anterior stops.*

The double iron consists of a semi-circle of metal covered

by a circular leather strap which encircles the leg just below the knee and buckles on the outer side. Two longitudinal metal bars are attached and fit into tubing in the heel of the boot.

Measurements.

1. Round the leg just below the knee joint.
2. From head of tibia to heel.

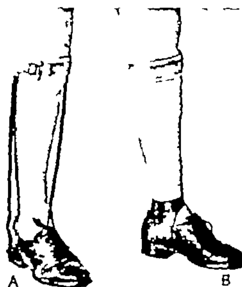


Fig 41.
A. Anterior view of double iron drop foot stops. B. Medial view of outside iron, showing the attachment of inside T strap (See Fig 40.)

State whether a right or left double iron is required. The boot is sent to the splintmaker for tubing and fitting of stops.

Single below-knee iron

This splint is similar in construction to the double iron, but there is a single longitudinal bar which fits into tubing in the heel of the boot. It is combined with a T-strap, i.e. a T-shaped piece of leather sewn on to the opposite side of the boot to which the iron is placed; the arms of the T pass over the iron and are fastened by means of a buckle. (Fig 41.)

The single iron is used to correct varus or valgus deformity of the foot. *It is placed on the side to which the foot is turned* so that the corrective force is applied on this side and increased by the pull of the T-strap fixed on the opposite side

An inside iron is therefore used to correct a varus deformity of the foot.

An outside iron is used to correct a valgus deformity (Chap VIII)

A T-strap may also be used in combination with a double iron or a caliper in cases in which a single iron would not provide sufficient support. It is placed on the opposite side to which the foot is turned and passes over the longitudinal bar of the double iron or caliper on the opposite side

Measurements for a single iron are exactly as for a double one State whether right or left inside or outside and send the boot to the splintmaker for tubing and application of the T strap.

Metal gutter splints (back splints)

These splints are made of malleable metal covered with felt. They are most useful splints and a large number in varying sizes should be kept in stock. They are used for the following purposes —

(1) *As temporary splintage in disease or injury of the lower limb* The back splint is then used in combination with a club-foot shoe and must be long enough to extend well above and below the site of disease or injury For example if it is used as temporary immobilisation in tuberculous or other inflammatory lesions of the knee-joint it must extend from the upper thigh to the lower calf.

(2) *As an adjunct to other splintage* Metal gutter splints are used in combination with a Thomas bed splint in tuberculosis or other inflammatory lesions of the knee (Chap XII) and in fracture of the femur (Chap XXVI)

(3) *As a knee splint* in injuries to the knee or after removal of a cartilage. (Chap XXVI.)

Club-foot shoe

This is a metal foot-splint consisting of a foot plate and a trough-like portion which supports the calf joined by a piece of metal which though shaped to fit the heel, is actually placed at a lower level. The great advantage of this is that the foot can be supported at a right angle to the leg whilst at the same time pressure on the heel is avoided. A detailed account of the application of these splints to support the feet in Pott's para-



Fig 42.
Useful emergency splintage for the lower limb. A. Plain club-foot shoe B. Metal gutter-splint (back splints) of various sizes C Winged club-foot shoe

plegia will be found in Chap X. The same technique may be employed in paraplegia due to fracture of the spine (Chap XXVII) Their use as temporary splints in combination with metal gutter-splints has already been mentioned. Club-foot shoes are also used to immobilise the foot and prevent strains of the knee in tuberculous or other inflammatory lesions of the knee joint (Chap. XII) In common with metal gutter-splints they are most useful to keep in stock. A club-foot shoe may be plain or winged as shown in Fig 42. The winged type is designed to be used in conjunction with a Thomas' bed splint the wings fitting over the longitudinal bars of the splint, as shown in Fig 147

Measurements.

1. From the toes to the heel
2. From the heel to the top of the calf.
3. The width across the base of the toes.

Crab-splint

This is occasionally used in cases of tuberculosis of the *ankle-joint* in which there are multiple discharging sinuses. (Chap. XIII.) In construction, it resembles a skeleton club-foot shoe and consists of a metal bar terminating in a curved expanded portion which supports the upper calf. The foot is



Fig. 43.
Crab-splint.

supported by a bar which fits behind the metatarsal heads and which is placed obliquely so as to conform with their arrangement. Two further malleable bars support the ankle and lower calf. The splint is covered with leather and the bars are fastened by means of straps and buckles. (Fig. 43.)

Measurements.

1. From the tips of the toes to the upper border of the calf.
2. The width across the foot behind the metatarsal heads.
3. A cast of the limb is required.

Dennis Browne's club-foot splint

This splint is used in the correction of congenital talipes equino-varus. (Chap. XI.) It consists of two aluminium plates

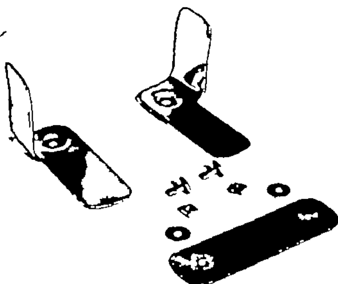


Fig 44.
Denis Browne's club-foot splints. (See text.)

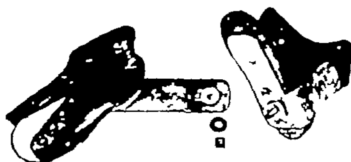


Fig 45
Denis Browne boots (See text.)
(by permission of John Wright & Sons, Bristol.)

bolted to a transverse bar of the same metal The sole of the foot rests on one plate whilst the other is in contact with the outer side of the ankle (Fig 44) After padding with felt, the foot pieces are strapped on and bolted to the transverse bar as shown in Chap VI Fig 70

Measurements —The length of the foot from the toes to the heel.

Dennis Browne boots are used as night splints in the later treatment of the same condition. They are bolted on to a transverse bar as shown in Fig. 45. The toes of the boots are left open to accommodate the growing foot so that the boots do not require renewal throughout the course of treatment

Measurements are as for Dennis Browne splints.

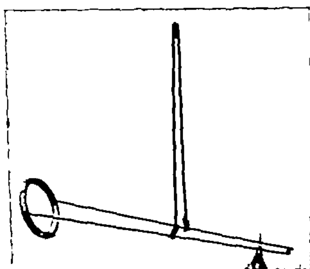


Fig 46.
Thomas' arm pl t fitted with Pearson flexion piece

Thomas' arm-splint

This is similar in construction to a Thomas' bed-splint except that the ring is hinged at its junction with the lateral bars. It is used occasionally in fractures of the humerus skin or skeletal traction is applied to the upper arm and fastened to the end of the splint whilst the elbow is flexed by means of a Pearson flexion-attachment (Fig. 46)

Measurements.

1 Round the arm in the axilla.

2. From the axilla to 10-12 ins. beyond the hand.

State whether a right or left arm splint is required

Measurement. The wedge is made according to the degree of abduction ordered by the surgeon.

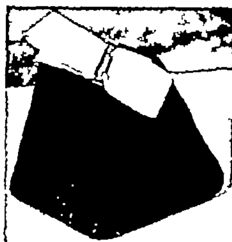


Fig. 49
Axillary wedge.

Elbow-cage

This splint may be ordered in the late treatment of tuber

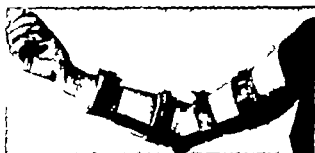


Fig. 50.
Jointed elbow cage.

culosis of the elbow joint or in any other condition in which a degree of protected movement of the elbow is required. It is similar in construction to a knee-cage. (Fig. 50.)

Measurements. A cast of the limb is required. State the range of movement to be permitted.



Fig 51.
Cock-up splint: suppl useful emergency fixation. A. Long cock up. B. Short cock up.

Cock-up splints

The long and short cock up splints shown in Fig 51 are used as purely temporary splintage in injuries to the wrist hand or fingers.

Measurements. *Long Cock up* From the finger tips to the middle of the forearm.

Short Cock up From the transverse creases in the palm of the hand to mid forearm.

Cramer wire

Cramer wire is used for making abduction splints to support the shoulder and arm, as for example in Erb's palsy (Chap XXIX, Fig. 210) The wire is bent to fit the part and is padded with wool covered by a gauze bandage.



Fig 5.
Casted block-leather jacket.

Moulded block leather splints

Block leather splints are made on a plaster cast of the part of the body or limb to be supported. The method of making the cast is described in Chap. IV The leather is soaked in water and then stretched tightly over the cast, so that it is moulded closely to its contours. Fig 21 shows

a block leather hip-spica in process of construction After the block leather has dried on the cast it is removed and sent for fitting The edges to be trimmed off are also marked at this time On return to the splintmaker the block leather is reinforced with metal strips and treated with varnish Fig 52 shows a moulded block leather spinal jacket and Fig 53 a block-leather wrist splint Block leather hip-spicas are shown in Fig 146.

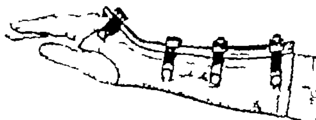


Fig 53.
Casted block leather wrist splint.

Shoe alterations

The nurse may be asked to advise patients as to the type of shoe suitable for alterations ordered by the surgeon. In general a shoe which the patient knows to be comfortable is preferable to a new one provided that it is in good repair and is otherwise suitable. A shoe presented for alteration should be a perfect fit and having a strong leather upper which is deep enough to embrace the foot firmly a straight inner border a rounded toe, and a wide flat heel. Women patients who are unused to wearing flat-heeled shoes may be averse to this, but they should be persuaded to adopt this type of shoe except on dressy occasions. In general, slip-on shoes or those fastened by means other than lacing are not suitable and crêpe soles are definitely contra indicated Children are often best served by the Start Rite type of shoe it is essential that they do not become out-grown and that they are kept in good repair

Inside raising to the heel—*crooked heel* may be ordered in any condition in which inversion of the foot is desired notably in flat foot and in knock knee (Chap XIII) It consists of a piece of leather of a thickness decided upon by the surgeon, placed between the upper and the sole on the inner side of the

heel of the shoe (Fig 54) More rarely inside raising is also applied to the sole of the shoe

Single Thomas heel—*Inside raising of elongated heel—crooked and elongated heel* is ordered in the same conditions when a greater degree of inversion of the foot is desired. (Fig 54)

Double Thomas' heel. The crooked elongated heel is prolonged until it merges with the sole It is ordered when still greater inversion of the foot is desired (Fig 54)

Outside raising to the heel of the shoe is applied in the same way as inside raising It is ordered only in the late treat



Fig 54

Shoe alterations. A. Inside raising to heel (crooked heel) B. Single Thomas heel (crooked and elongated heel). C Double Thomas heel. D Metatarsal bar

ment of congenital talipes-equino-varus (Chap VI) and occasionally in the treatment of strain or rupture of the external collateral ligament of the ankle-joint (Chap XXVI)

Metatarsal bar This consists of a strip of leather nailed to the sole of the shoe behind the metatarsal heads. It is placed obliquely so as to conform with the arrangements of the metatarsal bones. (Fig 54) It is ordered in any condition in which it is desirable to relieve weight-bearing on the metatarsal heads, as in claw foot hallux valgus and metatarsalgia. (Chap VIII.)

Insoles

Insoles are made of leather and are worn inside the shoes. They are convenient for the patient as they can be transferred from one pair of shoes to another

An insole with metatarsal button or bar (Fig 55) is

ordered for the same purpose as a metatarsal bar to the shoe.

To trace for an insole with metatarsal bar or button Place a little ointment on the sole of the foot behind the metatarsal heads previous experiment with felt pads and strapping should have determined its exact situation (Fig 87) The patient then stands and places the foot on a piece of paper and a tracing is taken by holding a pencil upright and outlining the foot An impression is left by the ointment which indicates



Fig 53.
A. Insole with metatarsal bar B. Insole with inside raising to heel. C. Insole with metatarsal button.

the situation of the button. It is necessary to outline this, or the ointment may soak into the paper and cover too large an area.

Insoles with inside raising to heel and/or sole may be ordered in cases of flat foot A tracing of the foot is required.

Moulded leather insoles are made on a cast taken with the foot held in the desired position. They are ordered in conditions in which support for the foot is required as in permanent flat foot. (Chap. VIII)

CHAPTER VI

CONGENITAL DEFORMITIES

Torticollis. Congenital torticollis. Clinical features. Treatment. Operative treatment. Acquired torticollis. Congenital dislocation of the hip joint. Pathological changes. Symptoms and signs. Treatment. Conservative treatment. Putti's mattress. Manual reduction and plaster fixation. Frog plaster. *Nursing care.* Reduction by traction and cross pull on double abduction frame. Nursing care. Later treatment. Operative treatment. Congenital talipes equino-varus. Clinical features. Treatment. Correction by manipulation. Method of maintaining correction. Application of strapping. Application of Denis Browne splints. Application of plaster. Nursing care. Later treatment. Operative treatment. Congenital talipes calcaneo-valgus.

TORTICOLLIS (Wry-neck)

THIS is a *deformity of the neck in which there is rotation* of the head to one side and lateral flexion to the other. It may be congenital or acquired; the congenital type is by far the more common.

The cause may be (1) in the cervical spine itself or (2) in the muscles controlling it.

(1) **Causes in the cervical spine** *may be*—(a) *Congenital*, due to hemi-vertebrae or spina bifida. (b) *Acquired*, due to an inflammatory lesion such as tuberculosis or osteomyelitis.

(2) **Causes in the muscles controlling the cervical spine** may be—(a) *Congenital*, due to injury to the *sterno-cleido-mastoid* muscle at birth (e.g. during forceps delivery) causing a haematoma called a "sterno-mastoid tumour". This may later result in an ischaemic condition in the muscle. (b) *Acquired* torticollis may be postural, paralytic, rheumatic or spasmodic. These types will be described later.

Congenital torticollis. *Clinical features.* The child is brought to the surgeon as the parents notice that he "holds his head on one side". On examination it will be seen that the head is rotated to one side and flexed to the other, and on this side the shoulder may be raised. This is due to contracture of

the sterno-cleido-mastoid muscle on one side which turns the head so that the chin points towards the normal side and the neck flexes laterally towards the affected side (Fig 56) On attempting to correct the deformity the sterno-cleido-mastoid stands out as a tight band, the maximum contracture being in the clavicular head of the muscle In patients in whom the deformity is of long standing there will be facial asymmetry



Fig 56.
Left torticollis.

due to an attempt on the part of Nature to maintain the eye level This results in the features of the affected side being smaller than those of the other

Treatment *No treatment is advised until disease of the cervical spine itself has been excluded by X-ray examination.* It may be conservative or operative Operative treatment is undertaken in late cases or when conservative measures have failed after reasonable period. In older patients, if the deformity is not severe interference is not as a rule advised as the facial asymmetry will persist and become more noticeable and there may also be complications such as headache and giddiness following alteration of the eye-level

Conservative treatment. In early life passive stretchings

to the affected muscle are given as soon as possible after birth The mother is usually taught to do this by a physiotherapist, but the nurse may be called upon to assist The baby lies on a firm couch, and while its shoulders are held by an assistant the head is gently but firmly flexed away from the affected side and rotated towards it Great care must be taken in handling the baby's head The baby may also wear a collar made of newspaper rolled in a handkerchief or other soft material. Re education is commenced when the child is old enough to follow moving objects with his eyes.

Operative treatment. In an older child, the most usual treatment is open or subcutaneous tenotomy of the sterno-mastoid muscle followed by fixation in the over-corrected position either between sandbags with a towel over the forehead or by



Fig 57
Plaster cast applied after operative correction of right sided torticollis.

plaster fixation (Fig 57) If sandbags are used post-operatively it is the nurse's duty to see that the head is held continuously in the over-corrected position, i e flexed away from the affected side and rotated towards it— chin towards the dressing The arm on the affected side may be tied down to the

bed. Passive stretchings and active exercises are introduced immediately. The patient must be fed and washed and is not allowed to sit up. The position is maintained for about ten days, when a collar may be applied and the patient is allowed up. (Fig 58.) In addition to the special stretchings and exercises, the child is given general postural exercises and taught self-correction in front of a mirror. The collar is worn until the patient can voluntarily hold the over-corrected position.



Fig 58.
Left-sided torticollis wearing collar. The axillary strap shown in Fig 33 has been omitted in this case.

Plaster fixation. If plaster fixation is used, the child's hair must be cut and perfectly clean, otherwise pediculi capitis will multiply beneath the plaster. The plaster is dried as described in Chap IV, and the same care is needed. It is worn for about six weeks.

Acquired torticollis. *Postural torticollis* is due to habitual bad head position and is usually associated with other postural deformities such as scoliosis, or with defective sight or hearing

Treatment Passive stretchings and active exercises are given, combined with general postural breathing and setting up exercises and attention to the general health. Predisposing causes, such as inadequate lighting and seating accommodation in school, are removed Defective sight or hearing will be dealt with

Paralytic torticollis is caused by paresis or paralysis of



Fig 59
Traction applied by means of a head harness for spasmodic torticollis. The head of the bed is raised to supply counter traction.

one sterno-mastoid muscle when its opponent is working normally The head is bent to the side of the healthy muscle and rotated away from it The paralysis may be due to poliomyelitis or to damage to the spinal accessory nerve (e.g during removal of glands of neck)

Treatment usually consists of plaster fixation in the corrected position followed by strengthening exercises for the weak muscle and stretching exercises for the healthy one

Rheumatic torticollis is a myositis of the sterno-mastoid and trapezius or other neck muscles caused by draughts, or by absorption of toxins from a septic focus elsewhere in the body (e g septic teeth, tonsils, or glands of the neck) The shoulder

muscles are often involved too The deformity is not as a rule a severe one.

Treatment usually consists of local heat electrotherapy and exercises with attention to the general health and removal of the underlying cause

Spasmodic torticollis is usually associated with some other disorder of the central nervous system. It may follow a general illness, especially if there is long continued sepsis.

Treatment consists of removal of the underlying cause and improvement of the general health. Physiotherapy is usually ordered and traction by means of a head suspension apparatus is sometimes used (Fig 59) This type of torticollis is disappointing and difficult to treat

Torticollis due to bony disease requires general treatment and immobilisation as described elsewhere

CONGENITAL DISLOCATION OF THE HIP JOINT

This is a partial or complete displacement of the femoral head from the acetabulum It may be unilateral or bilateral it is more common amongst girls and tends to run in families. The cause is thought to be (1) an error of development (2) intrauterine pressure

Pathological changes. (1) *In the bones.* The acetabulum is shallow and shelving, and does not develop normally owing to the displacement of the femoral head and consequent lack of functional demand. A false acetabulum develops with weight bearing if the femoral head is so displaced as to rest on the dorsum of the ilium The femoral head is displaced upwards and backwards and either stands away from the acetabulum or rests on the dorsum ilii. It is large in comparison with the acetabulum and is often flattened The femoral neck is shortened and anteverted (i e bent forwards) and coxa vara is present

(2) *Changes in soft structures* The capsule is stretched, and is said to assume an hourglass shape with a central constriction which may prove an obstacle to reduction. The adductor muscles, tensor fascia femoris and sartorius shorten, while the obturators and quadratus femoris are stretched. Gluteus medius and minimus become shortened and are at a mechanical disadvantage

Symptoms and signs. (1) *In early life before weight bearing* the observant nurse or mother may notice that the legs cannot be fully abducted. The perineum is abnormally broad and the buttocks flattened. Sometimes a swelling in the gluteal region denotes the displaced position of the femoral head.

(2) *In later life after weight bearing has commenced* there is a limp which may be slight at first and becomes more marked as the child grows. In unilateral cases, the limp takes the form of a dip to the affected side and there will be shortening of the limb. *If the condition is bilateral* there will be a dip to both sides, resulting in a waddling gait and the legs will appear short in comparison with the trunk. The perineum is wide, the buttocks broad and flattened and there is a lumbar lordosis due to the forward tilt of the pelvis. In both unilateral and bilateral cases there is prominence of the great trochanter, limitation of abduction and external rotation and flexion deformity. There is a hollow in the groin which is normally filled by the femoral head and the femoral vessels may be difficult to palpate.

Telescoping may be elicited, i.e. the limb can be moved upwards and downwards in its long axis.

Trendelenburg's sign. This can be elicited by asking the patient to stand on first one leg and then the other. When standing on the affected side the pelvis drops on the sound side due to the failure of the gluteus medius and minimus to keep the pelvis level. This is due to their shortening and inability to contract when weight is borne on the affected side. In bilateral cases, this sign is present on both sides.

X rays will show the degree of displacement of the head and a small ill-developed acetabulum.

Treatment. The earlier this is instituted the better the outlook, as once the femoral head is replaced in the acetabulum normal development and growth will proceed.

Aims of treatment. To reduce the dislocation, to maintain reduction, and to preserve the normal contours and function of the joint.

Conservative treatment. (1) *Putti's mattress.* This consists of a solid triangular wedge which is inserted between the child's legs. It is secured by a series of straps, and the degree of abduction is gradually increased. It is removed daily for cleansing and the limb is m[illegible] gently m[illegible] and into

abduction and internal rotation. This method of treatment is useful only during the first year of life. (Fig 60)

(2) Manual reduction and plaster fixation. The dislocation is reduced by manipulation under anaesthesia and X ray control. Plaster fixation may be —(a) Frog plaster (b) Batchelor plaster

(a) Frog plaster *This extends from the nipple-line to the* ankles and is applied on a hip-prop with the hips in full abduc



Fig 60
Putt mattress (*Frog horse*)

tion and external rotation and the knees flexed to the right angle. (Fig. 61)

Immediate nursing care. When the plaster is wet, it is supported on three firm pillows, covered with waterproof material and arranged as shown in Fig. 61. A suitable receptacle such as a kidney dish is kept in position to prevent soiling of the plaster until regular habits are established. Other nursing details will be found in Chap IV

Daily nursing care. These patients are healthy children and should be allowed to develop as such Once the plaster is dry and so long as it remains in good repair activity within the limits of splintage is encouraged for example the child is allowed to crawl about the floor If of a suitable age he should sit at a table for meals and should be encouraged



Fig 61
Frog plaster

to play with other children. Contamination of the plaster is avoided by the following means —

(a) Training the child in regular habits, e g holding out or potting in children who are accustomed to it.

(b) In very young children a suitable receptacle is kept in position until such time as regular habits are established.

(c) It is sometimes advisable to cover the plaster with jaconet in the region of the genitals, or to arrange a piece so that it falls from the buttocks into a receiver and forms a water shed

Later treatment. The frog plaster is retained for about nine to eighteen months, or until it is thought that reduction is secure The child may then be allowed to kick free in bed over pillows, or successive plasters are applied at four monthly intervals, reducing the angle of flexion and abduction each time

(b) **The Batchelor plaster** After reduction, the legs are encased in plaster from the groins to the ankles, in full abduction and internal rotation The plasters are then attached to a

abduction and internal rotation. This method of treatment is useful only during the first year of life. (Fig 60)

(2) **Manual reduction and plaster fixation.** The dislocation is reduced by manipulation under anaesthesia and X ray control Plaster fixation may be —(a) Frog plaster (b) Batchelor plaster

(*a*) **Frog plaster** This extends from the nipple-line to the ankles and is applied on a hip-prop with the hips in full abduc



Fig 60
Putti s mattress (*Fe quharso*)

tion and external rotation, and the knees flexed to the right angle. (Fig 61.)

Immediate nursing care. When the plaster is wet it is supported on three firm pillows, covered with waterproof mat erial and arranged as shown in Fig. 61 A suitable receptacle such as a kidney dish is kept in position to prevent soiling of the plaster until regular habits are established. Other nursing details will be found in Chap. IV

Daily nursing care. These patients are healthy children and should be allowed to develop as such. Once the plaster is dry and so long as it remains in good repair activity within the limits of splintage is encouraged for example the child is allowed to crawl about the floor If of a suitable age he should sit at a table for meals, and should be encouraged



Fig 61
Frog plaster

to play with other children Contamination of the plaster is avoided by the following means —

(a) Training the child in regular habits, e.g holding out or potting in children who are accustomed to it.

(b) In very young children, a suitable receptacle is kept in position until such time as regular habits are established.

(c) It is sometimes advisable to cover the plaster with jaconet in the region of the genitals, or to arrange a piece so that it falls from the buttocks into a receiver and forms a water shed.

Later treatment. The frog plaster is retained for about nine to eighteen months, or until it is thought that reduction is secure The child may then be allowed to kick free in bed over pillows, or successive plasters are applied at four monthly intervals, reducing the angle of flexion and abduction each time

(b) **The Batchelor plaster** After reduction, the legs are encased in plaster from the groins to the ankles, in full abduction and internal rotation The plasters are then attached to a

broomstick. Fixation is thus achieved whilst allowing flexion and extension at the hip-joint

Nursing care is similar to that required for broomstick plasters. (See Chap XL)



Fig 62.

First stage in reduction by traction and cross-pull Strong traction is exerted by skin extension and by tying the frame to the raised foot end of the bed.

Treatment on removal of plaster consists of free mobilisation and exercises in bed, followed by re-education in walking Supervision is continued until growth has ceased

(3) **Reduction by traction and cross-pull on double abduction frame** A *double abduction frame with C-shaped cross-bar* and two saddles is required. One saddle is of the ordinary type, while the other has leg portions abducted to 180 (Fig 30)

Method. Skin extensions are applied and the child is immobilised on the frame as described in Chap XI At first the hips are held in about 20 abduction and strong traction is exerted (Fig 62) It is usually necessary to tie the frame to the foot of the bed, which is elevated so that strong counter traction is provided and the pressure of the groin strap is relieved. When check X rays show that the femoral head is opposite the acetabulum, gradual abduction is commenced increasing it

a few degrees every second day When the 80 or 90 position has been reached and further X rays show that the head still remains opposite the acetabulum, abduction is further increased and cross-pull commenced. (Fig 63)

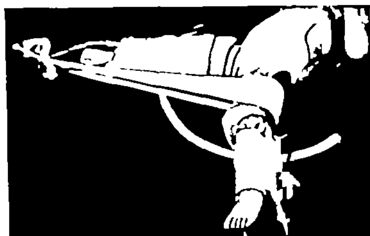


Fig 63.
Showing the method f ppl i g cross pull. (See text)

Cross-pull requirements —A small metal gutter splint moulded to the shape of the patient s thigh a piece of felt and a strong bandage or piece of ticking

Method of application Cover the gutter splint with felt and place it on the outer side of the patient s thigh Slip the bandage under the limb bring it round the gutter splint and tie it to the frame on the opposite side.

In bilateral cases, the same procedure is adopted on the other side The degree of abduction is then further increased traction and cross-pull always being maintained until the 180 position has been reached. At this stage there should be clinical and radiological evidence that reduction is complete (Fig 64)

Nursing care. This is similar to that described in Chap XI for a patient on an abduction frame The following special points should be noted

General care In older children sedatives may be necessary for the relief of pain. This method of treatment is not as a rule ordered for patients over the age of six years

ragalus can be seen and felt on the dorsum of the foot and that part which escapes from between the malleoli becomes broadened. The calcaneus is tilted medially so that the heel is small, poorly developed and tucked up and scaphoid and cuboid become displaced inwards. The skin on the dorsum of the foot is stretched and thin and there are abnormal creases on the inner border and on the sole.



Fig 66.
Right congenital club-foot.

In many cases, there is genu valgum. If weight bearing is attempted, bursae and callosities develop along the outer side of the foot and the gait is stumbling and difficult.

Treatment depends upon the stage at which the deformity is first seen. *Ideally it should commence as soon as possible after birth.* In a young baby treatment consists of correction of the deformity by frequently repeated manipulation.

Method of manipulation. The baby lies on the lap of an assistant or on a convenient table. The mother should not be permitted to see the manipulation during the early stages of treatment. An assistant protects the knee from strain by grasping the calf in both hands. This is essential in order to prevent genu valgum. *The inversion and adduction of the foot is corrected first and the plantar flexion last.* We will now assume *that the right foot is to be corrected.* Whilst an assistant protects the knee, place both thumbs on the head of astragalus, pressing it back into the mortice of the tibia and fibula; the fingers of the left hand pass round the outer side of the foot and grasp the heel, and the fingers of the right hand pass round

the inner side of the foot (Fig 67) Whilst exerting pressure with the thumbs, draw the foot *downwards* then *outwards* and *upwards* so that the toes describe a complete semi-circle Unless this manoeuvre is carried out the astragalus will not be replaced, correction will occur at the mid tarsal joint only and a bent shaped foot will result As the foot is drawn outwards, the adduction and inversion is corrected when it is certain that this is accomplished the fingers which grasp the heel pull it slowly downwards, and the foot is dorsiflexed. During the pro-

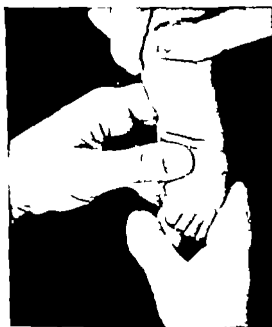


Fig 67
Showing position of operator hand during manipulation of a congenital club-foot.

cedure do not release your grasp or allow the foot to fall back into the deformed position even for a moment The manoeuvre must be performed as it were in one fell swoop not in a series of disjointed movement Allowing the foot to fall back only increases reactionary swelling

Methods of maintaining correction. After manipulation,

the foot is held in the over-corrected position by one of the following —

(1) Adhesive strapping (2) Dennis Browne splints. (Fig 44.) (3) Plaster fixation.

In very young babies, adhesive strapping is generally advised. After the age of three months, when the child is able to kick, Dennis Browne splints may be used. Later still plaster fixation may be employed.

Application of strapping Prepare beforehand a strip of adhesive tape about 2 ins. wide, according to the size of the foot, and long enough to extend up to the knee Place a piece of lint on the strapping to protect the skin, leaving about 1 in. free at each end. Lay the sticky piece on the dorsum of the foot carry the strapping round the inner side of the foot, under the sole then encircle the foot and whilst maintaining full correction, attach it to the outer side of the leg just below the knee. (Fig 68) In older children, the strapping may be carried above the knee A further strip encircles the leg just above the ankle. The strapping must pass directly beneath the calcaneo-cuboid joint Failure to support this joint will result in a boat-shaped foot Strapping is renewed at two or three day intervals, and the manipulation is repeated each time further strapping can sometimes be applied over the original application. J-shaped aluminium banana splints may be used in conjunction with the strapping



Fig 68.
Method of applying corrective strapping in congenital club-foot

Application of Dennis Browne splints. Remove the foot pieces from the cross-bar Pad the outer side of the sole piece with adhesive felt in such a way as to elevate the outer side of the sole of the foot and produce eversion (Fig. 69) After manipulation apply the sole-pieces, strapping them on firmly The leg piece projects outwards from the leg. This in turn is strapped on, and pulls the foot into valgus. Both sole pieces

are then fastened to the cross-bar pointing outwards in as much external rotation as can be gained (Fig 70) If there is a normal foot it i arranged in a normal position but pointing outwards about 20 The child is encouraged to kick and stand in the splint It provides correction whilst allowing development of the musculature Re-manipulation and re-application is generally required about once weekly Later Dennis Browne boots may be worn. They unlace completely so that the toes stick out of the open ends as the child grows (Fig 4)



Fig 69
Dennis Browne splints. The right foot-piece has been padded with adhesive felt so as to elevate the outer side of the foot. (Nagler)



Fig 70
Dennis Browne plates are applied so that the sole pieces point outwards in as much external rotation as can be gained. (Nagler)

Application of plaster The plaster may be skin tight but it is usual to cover the limb with wool roll While correction of the deformity is maintained, apply the plaster in the usual way carrying the bandage from within outwards. Firm pressure is applied beneath the calcaneo-cuboid joint In young children, the knee is usually flexed to a right-angle and included in the plaster this tends to prevent the child kicking the plaster off A strip of elastoplast applied round the leg beneath the top of a below knee plaster will prevent the child kicking it off Plasters are changed when necessary

Nursing care. Whatever method of fixation is chosen, the nursing points to be observed are summarised under one heading

(1) These children are generally treated as out patients. *Never allow the child to leave the hospital or clinic until you*

are satisfied that the circulation in the toes is adequate Instruct the child's mother to observe the toes and to get in touch with you *at once should anything* untoward occur Some swelling of the toes is to be anticipated, but they should be pink and flush rapidly with blood on release of digital pressure. Gross swelling combined with discolouration is a matter for concern. *The fixation may have to be renewed but it is never removed altogether and there is no excuse for losing the correction gained.* A posterior plaster slab in the corrected position can be applied as a temporary measure.

(2) The skin must be kept clean and dry During renewal of splintage wash the leg and foot carefully always maintaining the corrected position. *Pay* special attention to areas which have received pressure Rub the leg with a little ether or spirit. Make every effort to keep the splintage dry A small piece of felt or cardboard may be used to protect the base of the great or little toe from pressure. Always put strapping *on a slightly differe*[illegible] *rea of skin each time it is renewed Never cease the splinting because of pressure sores or skin irritation* A *partly corrected foot that is set free will become more resistant to treatment than one which has never been touched.*

Later treatment. As a rule, treatment commenced soon after birth results in complete correction at the age of six months to one year The child is carefully observed when walking commences. Dennis Browne boots or plaster shells may be worn at night As soon as he is old enough to co-operate *muscle re education* is commenced *with special reference to the evertors* and dorsiflexors of the foot Re-education in walking is essential. An inside-iron outside T strap with outside raising to the heel of the shoe is occasionally ordered, especially in those cases in which there is weakness of the evertor muscles. When *examining the* child at an After-care Clinic, note whether the tendo-achilles retains its length Contracture of this tendon is the first sign of relapse Supervision is continued until growth has ceased, as relapsed cases are difficult to treat.

Operative treatment may consist of elongation of the tendo-achilles, tenotomy of tight structures and wrenching, or some other soft tissue operation. Old untreated cases may

require stabilisation of the foot and amputation may be advised in the case of untreated adults.

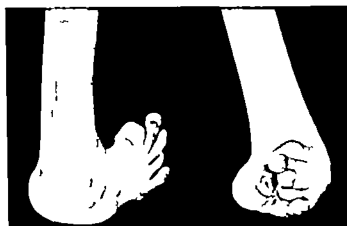


Fig. 71.
Untreated congenital club foot in an adult.

Congenital talipes calcaneo-valgus

In this deformity the foot is dorsiflexed and everted, and the tendo-achilles is lengthened. The deformity is the exact opposite of that seen in club-foot but it is more amenable to treatment. There may be a club-foot on the opposite side.

Treatment consists of a complete plaster or an anterior plaster shell holding the foot in equino-varus. Inside raising to the heel of the shoe and foot exercises may be ordered when the child begins to walk.

are satisfied that the circulation in the toes is adequate Instruct the child's mother to observe the toes and to get in touch with you *at once* should anything untoward occur Some swelling of the toes is to be anticipated but they should be pink and flush rapidly with blood on release of digital pressure Gross swelling combined with discolouration is a matter for concern. *The fixation may have to be renewed but it is never removed altogether and there is no excuse for losing the correction gained* A posterior plaster slab in the corrected position can be applied as a temporary measure.

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Later treatment. As a rule, treatment commenced soon after birth results in complete correction at the age of six months to one year The child is carefully observed when walking commences. *Dennis Browne boots or plaster shells may be worn* at night As soon as he is old enough to co-operate, *muscle re-education* is commenced, with special reference to the evertors and dorsiflexors of the foot Re-education in walking is essential An inside-iron outside T-strap, with outside raising to the heel of the shoe is occasionally ordered, especially in those cases in which there is weakness of the evertor muscles. When examining the child at an After-care Clinic, note whether the tendo-achilles retains its length Contracture of this tendon is *the first sign of relapse* Supervision is continued until growth has ceased, as relapsed cases are difficult to treat.

Operative treatment may consist of elongation of the tendo-achilles, tenotomy of tight structures and wrenching or some other soft tissue operation Old untreated cases may

are given to strengthen the entire musculature with special emphasis on the erector spinae and transverse shoulder muscles.

Structural kyphosis is due to the following conditions —



Fig. 72.
Dorsal kyphosis of severe degree.



Fig. 73.
Lordosis due to poliomyelitis affecting the abdominal and gluteal muscles.

(a) *Congenital wedging of vertebrae* Treatment consists of spinal exercises and support such as a Jones spinal brace.

(b) *Inflammatory conditions* such as tuberculosis. Treatment consists of general measures and immobilisation as described elsewhere. (Chap X.)

(c) *Epiphyseal derangements* *Scheuermann's disease* and its treatment is described in Chap XX *Calvé's disease* is a similar condition but only one vertebra is affected as opposed to Scheuermann's disease in which several vertebrae are involved. Treatment consists of immobilisation on a frame or plaster bed followed by a spinal support and exercises.

CHAPTER VII

DEFORMITIES OF THE SPINE

(KYPHOSIS LORDOSIS, SCOLIOSIS)

Function of the spine. Kyphosis. Postural kyphosis. Treatment. Structural kyphosis. Lordosis. Causes. Treatment. Scoliosis. Postural scoliosis. Structural scoliosis. Congenital scoliosis. Acquired scoliosis. Aims of treatment. Treatment of postural scoliosis. Treatment of structural scoliosis. The Risser turnbuckle jacket.

THE spine is an organ of great flexibility subservient to the motor functions of the whole body. Its mechanical function can be summarised as follows —

(1) It is a sustaining rod, maintaining the upright position, and carrying the weight of the body

(2) It is an anchorage for powerful muscles, not only for those of the trunk, but for those of the shoulder and pelvic girdles

(3) It is a buffer spring receiving in endless and rapid sequence innumerable jars and jolts associated with the function of the body

(4) It is a casing of safety for the spinal cord and nerves.

Kyphosis is said to be present when there is an exaggeration of the normal dorsal curve (Fig 72) it may be *postural* or *structural*.

Postural kyphosis is due to habitual bad position.

Predisposing causes. Weak musculature, especially at the period of rapid growth other predisposing causes include mouth-breathing defective sight or hearing bad seating or lighting in schools, tight clothing and mental apathy There may be a poking chin contracture of the pectoral muscles, and rounding of the shoulders A compensatory lordosis may be present, and the hip flexors and hamstrings may be contracted.

Treatment includes removal of underlying causes, attention to the general health and intensive physiotherapy Exercises

are given to strengthen the entire musculature with special emphasis on the erector spinae and transverse shoulder muscles.

Structural kyphosis is due to the following conditions —



Fig. 72.
Dorsal kyphosis of severe degree.



Fig. 73.
Lordosis due to poliomyelitis affecting the abdominal and gluteal muscles.

(a) *Congenital wedging of vertebrae* Treatment consists of spinal exercises and support such as a Jones spinal brace

(b) *Inflammatory conditions* such as tuberculosis. Treatment consists of general measures and immobilisation as described elsewhere. (Chap X)

(c) *Epiphyseal derangements* *Scheuermann's disease* and its treatment is described in Chap XX *Calvé's disease* is a similar condition but only one vertebra is affected, as opposed to Scheuermann's disease in which several vertebrae are involved. Treatment consists of immobilisation on a frame or plaster bed, followed by a spinal support and exercises.

(d) *Spondylitis ankylopoetica.* (Chap XVIII)

(e) *Kummel's disease* is a crumbling collapse of one vertebral body following injury Gross collapse may result in paraplegia. Treatment consists of immobilisation on a frame or plaster bed, followed by a spinal support or plaster jacket, combined with hyperextension exercises. A spinal fusion may be advised

(f) *Osteo-arthritic kyphosis* is treated by rest support and physiotherapy (Chap XVI)

Lordosis is said to be present when there is an exaggeration of the normal lumbar curve (Fig 73)

Causes include the following —

(a) It may be compensatory to kyphosis.

(b) It may be compensatory to flexion deformity of the hip-joint as in congenital dislocation of that joint

(c) Wrong idea of posture

(d) Weakness or paralysis of the abdominal or gluteal muscles.

(e) Muscle inbalance as when there is contracture of the hip-flexors with long hamstrings and an increased forward tilt of the pelvis. Short hamstrings with backward tilting of the pelvis produces a short, sharp lordosis which is accompanied by a long gradual kyphosis.

(f) Inflammatory lesions, such as tuberculosis.

(g) Traumatic lesions, such as a fracture of the spine *Spondylolisthesis*, a condition in which the fifth lumbar vertebra becomes displaced forward on the sacrum following trauma, produces a varying degree of lordosis.

Treatment depends upon the cause Those cases in groups (a) and (b) require correction of the primary deformity Groups (c) (d) and (e) are treated by exercises. Group (f) and (g) require immobilisation as described elsewhere Fusion of the spine is sometimes indicated

Scoliosis is a deformity of the spine in which there is lateral bending with rotation. The deformity is described

according to the region affected and the direction of the curve for example right dorsal, left lumbar scoliosis. (Fig 74) A deviation of the whole of the spinal column to one side is known as a total or C curve. A curve in one direction with compensatory curves above and below in the opposite direction is known as an S curve.

The deformity may give rise to no disability though there is generally some complaint of fatigue or of pain in the back. Gross deformity may eventually lead to respiratory cardiac or abdominal upsets.

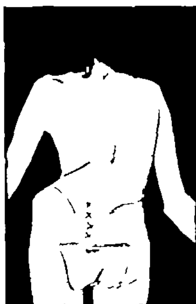


Fig 74.
Right dorsal left lumbar scoliosis of severe degree.

There are two main types of scoliosis —

(1) *Postural scoliosis* is due to habitual bad position and can be voluntarily corrected by the patient.

(2) *Structural scoliosis* is due to structural changes in the part involved. It cannot be corrected by the patient's efforts. Postural scoliosis may eventually become structural, as soft tissues and finally bones adapt themselves to position.

Scoliosis is further described as *congenital* or *acquired*. *Congenital scoliosis* is due to a structural defect of the vertebral column such as hemi vertebrae or absence of some vertebrae.

Acquired scoliosis may be classified under the following headings —

(1) Idiopathic scoliosis occurs in about 80 per cent of cases. It is most common in girls. Muscle weakness is an important factor

(2) Paralytic scoliosis is a sequel to poliomyelitis (Chap XXII.) and is the result of muscle imbalance.

(3) Rachitic scoliosis appears as a manifestation of rickets. (Chap XXI)

(4) Other types of scoliosis are due to the following conditions —

(a) Nervous diseases, such as spastic paralysis.

(b) Inflammatory disease of the spine, such as tuberculosis.

(c) Epiphyseal changes.

(d) Anatomical asymmetries, such as shortening of one leg

(e) Empyema.

(f) Sciatica. (Chap XIX)

Fig 5
St. Vincent skid ton splint used in case of scoliosis.

Treatment is decided by the following factors —

(1) The mobility of the spine. (2) The degree of rotation. (3) The amount of structural change.

The aim of treatment is to restore the alignment of the spine so that no scoliosis is apparent when the patient is dressed. This aim is achieved not only by correcting existing curves, but by *ensuring that individual curves are* compensated by others above and below the eyes, shoulders, and pelvis must be level so that the patient appears *straight and the deformity remains* static.

The prognosis is greatly dependent upon the musculature, and any correction gained must always be matched by muscular control

Postural scoliosis is tre otherapy
lance Exercises are given to re scle tone, I
balance of the whole body Sp are given
spinal muscles, and must be d ov
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Structural scoliosis may be treated by the following methods —

(1) Physiotherapy plus some means of support such as a corset a skeleton splint (Fig 7) a Jones spinal support or a casted block leather jacket similar to that shown in Fig 117



Fig 6.
Turnbuckle jacket applied for correction of right dorsal left lumbar scoliosis.

(2) Forcible correction followed by a permanent support or by operative fusion of the spine

The Risser turnbuckle jacket is the method of correction in current use The patient is immobilised in a spica jacket which in most cases includes the head and sometimes the arm (Fig 6) *The jacket is then split and by means of a turnbuckle the deformity is gradually corrected* The nursing care is the same

as for any other patient wearing a plaster jacket. When correction has been obtained, the patient is either fitted with a permanent support and physiotherapy continued, or spinal fusion is performed through a window in the jacket. Spinal fusion is most often performed for paralytic scoliosis.

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DEFORMITIES OF THE LEGS AND FEET

Coxa vara. Coxa valga. Genu valgum. Causes. Treatment. Girdlestone's mermaid splint. Manipulation and plaster fixation. Knock knee irons. Nursing care. Genu varum. Causes. Treatment. Genu recurvatum. Causes. Treatment. The arches of the foot. The support of the arches. Muscular supports. Causes of foot deformities. Pes planus. Types of flat foot. Acute foot strain. Clinical features. Treatment. Flat foot exercises. Other forms of physiotherapy. Altered shoes. Mobile or voluntary flat foot. Clinical features. Treatment. Mobile or voluntary flat foot in children. Treatment. Rigid or permanent flat foot. Clinical features. Treatment. Hallux valgus. Treatment. Operative treatment. Hallux rigidus. Treatment. Hammer toe. Treatment. Pes valgus. Clinical features. Treatment. Operative treatment. Talipes equinus. Treatment. Contracture of the tendo-achilles. Correction in plaster. Permanent drop-foot. Operative treatment. Pes cavus. Clinical features. Treatment. Operative treatment. Talipes calcaneus. Treatment. Talipes varus. Treatment. Metatarsus varus. Treatment. Metatarsalgia. Morton's metatarsalgia. Treatment.

COXA VARA, GENU VALGUM, GENU VARUM, GENU RECURVATUM

Coxa vara. The normal adult femur presents an angle between the femoral neck and shaft of between 120° and 140°. In coxa vara this angle is decreased. There is depression of the femoral neck, normal opposition of joint surfaces is lost, and the femoral head becomes ill fitting. The great trochanter is displaced upwards and there is limitation of abduction and internal rotation at the hip-joint. Bilateral coxa vara produces a waddling gait and a dip to the affected side is present in unilateral cases. There may be real shortening of the limb with external rotation deformity.

Coxa vara may be *congenital* or *acquired*.

Congenital or infantile coxa vara is due to constitutional or development diseases, such as achondroplasia.

Acquired coxa vara may be due to the following conditions:—

(a) Perthe's disease. (b) Destructive arthritis. (c) Congenital dislocation of the hip-joint. (d) Rickets. (e) Fracture

of the femoral neck. (f) Separation of the upper femoral epiphysis (adolescent coxa vara).

Treatment of the congenital type may be by osteotomy The acquired type requires treatment according to the cause.

Coxa valga is present if the femoral neck-shaft angle is increased. It occurs in conditions in which the patient has never walked.

Genu valgum (knock knee) This deformity is present when the medial malleoli cannot be brought together except by the knees overlapping each other (Fig 77) The medial collateral ligament becomes stretched and the knees unstable The degree of deformity is generally assessed by the amount of intermalleolar separation when the knees are in contact with each other



Fig 77
Bilateral genu valgum.

Causes include the following —(a) Bad posture and gait. (b) Weak musculature (c) Flat foot, which alters the line of weight bearing knock knee often accompanies weak valgoid feet in children. (d) Obesity (e) Traumatic lesions, such as a sprain or fracture. (f) Poliomyelitis. (g) Rickets and other bone dystrophies. (h) Inflammatory *lesions of the knee* (i) Knock-knee may be secondary to flexion-adduction deformity of the hip especially in patients wearing a short single spica. (j) A large number of cases are idiopathic.

Treatment is determined by the cause and by the degree of deformity Mild cases require inside raising to the heels of the shoes and exercises **The altered shoes are worn constantly** *No other shoes are worn weight-bearing without shoes is not permitted* The object of the inside raising is to relieve the strain on the medial collateral ligament and prevent overgrowth of the internal femoral condyle. Exercises are aimed at strengthening the musculature of the *leg particularly* the quadriceps. Re-education in walking is essential.

Girdlestone's mermaid splint may be ordered. Measurements are described in Chap. V.

Application. This splint is worn only at night. It is placed between the child's legs, a firm pad of wool is placed between the inner side of the knee joint and the splint, and the straps are fastened. The limbs are covered with a piece of splint wool and a firm bandage is applied around both legs and the splint between them. The bandage must extend to the groin and include the foot to the toes. It is essential that the legs and feet be exactly parallel to each other and that the feet and patellae point straight forwards. External rotation of the limb results in loss of the corrective force. During the day the patient wears altered shoes as already described.

Manipulation and plaster fixation. Successive plasters are applied, without anaesthesia, gaining more correction each time. Alternatively, wedged plasters may be used. This is followed by altered shoes, exercises, and re-education in walking.



Fig. 78.
Knock knee irons.

Knock knee irons are often ordered. Measurements are described in Chap. V.

Application. A boot is tubed to receive the iron (boots are to be preferred to shoes). The child lies on a couch and the iron is applied by fastening the straps around the thigh and ankle and inserting the prolongation into the tubed boot. Wind a layer of splint wool around the knee, take a firm cotton bandage and start to bandage from without in, taking three turns firmly round the knee-joint. The next three turns pass round the knee and the lateral bar of the splint. Finally, lip the leather pad (which is to prevent hyperextension of the knee) into

position at the back of the knee and finish by three further turns of bandage (Fig 78)

Nursing care. The child's mother must be instructed in daily re-application of the bandage It must be tight enough to maintain correction, but not tight enough to produce pressure-sores or interfere with the circulation or nerve-supply to the limb Unless otherwise ordered, the splints must be worn constantly *It is essential that the patella points straight forwards at all times.* External rotation of the limb renders the splint ineffective. Difficulty in holding the splint in the tubing may be overcome by the application of an inside T-strap Inside raising to the boots may be ordered to increase correction. Exercises are given daily to preserve the musculature.



Fig 79
Bilateral genu-varum.

Operative treatment usually consists of an osteotomy followed by fixation in a bed-splint or a plaster spica. Gross deformity due to an inflammatory lesion may require arthrodesis of the knee.

Genu-varum (bow leg) is present when both knees and both medial malleoli cannot be brought together It may be confined to the tibia only or it may affect the whole leg (Fig 79)

Causes include the following —(a) Bad posture and gait. (b) Rickets. (c) Diseases of bone such as osteomyelitis. (d) Injuries.

Treatment. *Conservative treatment* consists of manipulation without anaesthesia, and successive plasters wedged plasters may be ordered. Physiotherapy and re-education in walking is introduced when the plaster is discarded. *Operative treatment* consists of an osteotomy at the site of election, and plaster fixation until union is sound.

Genu-recurvatum (back knee) *is present when the knee is* hyperextended. (Fig. 80)

Causes include the following —

(a) Bad posture and gait especially in patients with long *hamstrings*.

(b) Weak musculature especially following long periods in recumbency when the knee is inadequately supported.

(c) Paralysis of the ham strings, as in poliomyelitis.

(d) Inflammatory lesions, such as *tuberculous*.

(e) Injuries to the knee joint.

Treatment. *Exercises* may be sufficient in mild cases. *Splintage* such as a caliper or knee-cage may be ordered. In nursing inflammatory lesions and injuries, special attention must be paid to *prevention* of this deformity.

Operative treatment consists of an osteotomy or an arthrodesis of the knee.



Fig. 60.
Genu recurvatum of severe degree

FOOT DEFORMITIES

(Pes planus, hallux valgus, hallux rigidus, hammer toe, pes valgus, talipes equinus, pes cavus, talipes calcaneus, talipes varus, metatarsus varus, metatarsalgia)

The foot is an elastic yet powerful structure consisting of a number of small spongy bones arranged in a series of arches. In standing the foot receives and transmits the entire weight of the body and in walking provides a resilient spring for its forward propulsion.

The arches of the foot. *The longitudinal arch* consists of an inner and outer portion which rest on a common pillar posteriorly the tuberosity of os calcis. The inner portion is

the higher and extends from os calcis behind to the head of the first metatarsal in front the remaining constituent bones being astragalus, scaphoid and the inner three metatarsals. The astragalus is the key-stone of the arch The outer portion is much lower and extends from os calcis to the outer two metatarsal heads, the cuboid intervening.

The transverse arch extends from the first to the fifth metatarsal head.

The supports of the arches. The arches are maintained by the following structures —(1) *The shape of the constituent bones* which in general are wedge-shaped so as to fit together like the stones used in masonry (2) *The interosseous ligaments* which bind the individual bones together (3) *The long ligaments of the foot* the *spring ligament* supports the inner portion of the arch passing from os calcis to scaphoid, and thereby supporting astragalus. The *long and short plantar ligaments* support the outer portion passing from os calcis to cuboid and the fourth and fifth metatarsals. The *plantar fascia* acts as tie-beam to the arch The *transverse ligaments* of the metatarsal heads serve as supports to the transverse arch.

Muscular supports. *The tibialis posticus* passes under the spring ligament to its attachment on all the bones of the foot except astragalus, and acts as a supporting sling *Tibialis anticus* also helps to maintain the inner part of the arch. These muscles are balanced on the outer side by the *peroneus longus*, which passes across the sole of the foot to its attachment on the plantar surface of the first metatarsal. The long flexors of the toes and the intrinsic foot muscles also help to support the longitudinal arch The transverse arch normally does not receive a great deal of weight and depends for its support upon the intrinsic foot muscles.

Foot deformities are therefore due to the following causes —

(1) Alteration in the shape of the bones

(2) Ligamentous changes

(3) Failure of the muscular supports

In a great many cases, the primary cause of deformity lies in weakness or imbalance of the muscles. Ligaments then

become stretched and weakened and bony changes eventually occur

PES PLANUS (Flat foot)

Flat foot is a deformity in which the arch of the foot is flattened to a varying degree. In childhood and adolescence it is usually due in the first instance to failure of the muscular support of the foot; the ligaments then become stretched, the shape of the bones altered, and the deformity becomes fixed. In later life there may be arthritic changes in the joints of the foot.

Predisposing causes. (a) General muscular hypotonus, either constitutional or due to disuse following illness or injury. (b) Too much standing or walking, as in the case of policemen and shop-assistants. (c) Obesity. (d) Knock-knee. (e) Ill fitting unsuitable shoes. (f) Bad posture in standing and walking. (g) Varicose veins.

Types of flat foot. There are three main types. (1) *Acute foot strain.* (2) *Voluntary or mobile flat foot.* (3) *Rigid or permanent flat foot.*

(1) **Acute foot strain** is generally seen in adolescents or young adults who have undertaken a job or recreation which taxes the foot musculature too heavily, as for example in the student nurse or week-end hiker.

Clinical features. The patient complains that the feet are hot and uncomfortable, that they burn and sweat, and that they swell towards the end of the day. Aching pain is felt on the front of the leg and under the base of the toes. The gait becomes stiff and clumsy and the pain may be so severe that the patient is confined to bed. Areas of local tenderness may be found, for example, under the spring ligament. There is no deformity.

Treatment. *Rest in bed* is usually ordered, with attention to the general health. *Change of occupation* may be advised in extreme cases.

Flat foot exercises are practised intensively. These should be non weight-bearing at first. The patient must thoroughly understand the necessity for their conscientious performance over a long period. Exercises should be simple and easily

practised at home three examples are given below —

(a) The patient stands with the feet together and turns them over so that weight is borne on the outer borders. The toes are curled under The position is held for a few moments and *slowly* relaxed.

(b) The weight is taken on the outer border of the foot as in Exercise (a) and the patient walks around the room whilst holding the position.

(c) Sitting with the knees bent and the feet together the patient reforms the arch and draws the heel towards the toes in a caterpillar movement.

Other forms of physiotherapy *Faradic foot baths* may be ordered to stimulate the muscles. *Contrast baths* improve the circulation and help to reduce swelling. The patient sits in front of two bowls or buckets containing hot and cold water respectively The feet are plunged into first one and then the other

Altered shoes. The inner side of the heel of the shoe is raised ⅛ in. ¼ in. or ⅜ in., according to the surgeon's orders. A Thomas heel may be ordered. (Chap V) The shoe must be flat-heeled well built and well fitting with a straight inner border

The patient receives the following instructions —

(a) Foot exercises must be carried out several times daily The patient should be encouraged to voluntarily restore the arch during idle moments for example when waiting for a 'bus. (b) Altered shoes only must be worn. Carpet slippers and gym shoes are not permitted (c) The patient must never walk bare foot

N B *Correct heel-and-toe walking and general postural training is essential in all cases*

(2) **Mobile or voluntary flat foot.** In this deformity the arch of the foot is flattened, but it can be voluntarily restored by the patient and manually restored when the foot is at rest.

Clinical features The deformity may be symptomless, or the patient may complain of similar symptoms to those experienced in acute foot strain but in a much milder degree. This type of flat foot may follow untreated foot strain. On exam-

ination, the arch of the foot is seen to be nearing the ground eversion of the foot is seen not only from the front but from behind (Fig 81) and painful callosities may form along the inner border of the heel

Treatment proceeds on the lines already described for foot strain the following additions may be advised —

(1) *Plaster fixation* in the corrected position for four to six weeks.

(2) *Arch supports* are seldom advised, as the patient



Fig 81.
Bilateral flat foot. X is the eversion of the heels. (*Naylor*)

becomes dependent upon them. They may however be necessary if the patient is unco-operative and may consist of a piece of bevelled felt strapped under the inner side of the arch, or a sponge-rubber support such as can be bought at a chemist s shop Occasionally a moulded leather support is made on a cast of the foot in the corrected position.

Mobile or voluntary flat foot in children. This is frequently seen in conjunction with knock-knee deformity particularly in children with long narrow feet and poor musculature It is often symptomless, though the child s mother may complain that the child tires easily and stumbles and falls a great deal

Treatment. (a) Inside raising to the heels of the shoes (b) foot exercises (c) a double iron is occasionally ordered. The patient and his mother will be instructed as already described these instructions are so important that they will now be repeated —

(1) The exercises are performed several times a day Boredom must be avoided the child may carry out the exercises to music, and is taught to pick up marbles or other objects with the toes.





Fig 82.
Rigid flat foot Note the eversion of the feet and the co-existing hallux valgus and hammer toes.

(2) The altered shoes must be worn constantly *no other shoes are worn.*

(3) The child must never bear weight even for a moment *unless wearing the altered shoes. The mother lifts the child* in and out of bed, and in and out of the bath so that the bare feet do not touch the floor

Rigid or permanent flat foot. This may be the end result of untreated voluntary flat foot The arch is so flattened that it rests on the ground and cannot be either voluntarily or manually reproduced.

Clinical features Pain and disability is usually due to adhesions or to osteo-arthritic changes in the joints of the foot Eventually the pain may disappear but the foot becomes completely stiff The arch may be so flattened that the tubercle of scaphoid or the head of astragalus is prominent on the inner side of the foot The feet may be so everted as to assume the quarter to three position, and the gait is plodding awkward and devoid of spring There is often co-existing hallux valgus or hammer toe (Fig 82.)

Treatment. (1) Any of the measures already described may be advised. (2) Manipulation under anaesthesia followed by plaster fixation in the corrected position (3) As a last resort stabilisation of the foot may be performed.

HALLUX VALGUS

This is a deformity of the great toe in which it is abducted away from the midline of the body (Fig 82.) It may pass under or over the second toe which often develops a hammer deformity An exostosis develops over the first metatarsal, and friction from the shoe eventually produces a bursa covered with horny skin this is commonly known as a bunion, and may eventually break down and suppurate.

In the early stages, hallux valgus may give rise to no trouble apart from its unsightliness and difficulty in wearing shoes, but in later life, osteo-arthritic changes give rise to increasing pain, stiffness and difficulty in walking.

Treatment. Conservative treatment is advised in early cases, particularly if it is associated with flat foot It consists of soft wide shoes with straight inner border manual stretching and foot exercises.

Operative treatment may consist of the following —

(1) Simple trimming of the metatarsal head is undertaken if there are *no osteo-arthritic* changes. A simple dressing and bandage is applied, foot exercises are commenced in a few days and weight-bearing in seven to ten days.

(2) Arthroplasty either by trimming of the first metatarsal head and excision of the proximal half of the first phalanx of the great toe (Keller's operation) or by excision of the head

of the first metatarsal. After-care consists of a simple dressing and bandage; gentle exercises are commenced about the fifth day and weight-bearing in about three weeks. Pulp-traction with plaster fixation is sometimes ordered, and maintained for about ten days.

HALLUX RIGIDUS

This is a deformity in which the big toe becomes stiff. In extreme cases, dorsiflexion is completely lost and the toe assumes a flexed position: this condition is known as "hallux flexus." The patient is unable to rise on the toes, and there is pain and difficulty in walking.

Treatment. Conservative treatment in mild cases consists of a metatarsal bar to the outside of the shoe or a metal plate worn inside the shoe. Foot exercises are also ordered.

Operative treatment usually consists of a Keller's operation.

N.B. In both hallux valgus and hallux rigidus correct foot-wear, foot exercises, and re-education in walking are an essential part of the after-care.

HAMMER TOE

This deformity consists of dorsiflexion of the proximal phalanx, plantar flexion of the second, and either flexion or extension of the distal phalanx. (Fig. 82.) The second toe is most commonly affected. The head of the first phalanx is subjected to pressure from the shoe and painful bursae and corns appear. It is commonly associated with other foot deformities, especially hallux valgus and pes cavus. It may be caused by squeezing the toes into ill-fitting shoes. The corn over the first phalanx gives rise to more symptoms than the deformity itself, and there is difficulty in fitting shoes, with pain and difficulty in walking.

Treatment. Conservative treatment consists of manual correction and foot exercises. Strapping may be used in mild cases to maintain correction, especially in children. In adults, small felt pads arranged to relieve pressure on the toe may alleviate the symptoms.

Operative treatment consists of an excision and arthrodesis

of the joints of the offending toe with correction of the deformity

PES VALGUS (Spasmodic flat foot)

This deformity is not as the name suggests, associated with spastic paralysis. The foot is everted due to spasm of the peroneal muscles. It is thought that this spasm is protective in nature and associated with derangements of the mid tarsal or sub-astragaloid joints.

Clinical features. This condition is generally unilateral the foot is very painful and walking is difficult. On examination the foot is strongly everted, and the peronei can be seen to stand out as a tight band behind the external malleolus.

Treatment. (1) Manipulation under anaesthesia followed by plaster fixation in the corrected position. The plaster is worn for six or eight weeks and may be followed by the application of an outside iron and inside T-strap and in any case is followed by foot exercises.

(2) *Operative treatment* may be —(a) Tenotomy of the peronei, followed by plaster fixation (b) Stabilisation of the foot is often the ultimate fate.



Γ
Equinus deformity of the foot following poliomyelitis.

TALIPES EQUINUS (Drop-foot)

This deformity is said to be present when the foot cannot be dorsiflexed. (Fig. 83.) It may be a postural deformity and due to pressure of bedclothes or neglect of foot-exercises, espec-

tally in very ill or debilitated patients, or it may be caused by diseases of the central nervous system in which there is muscle imbalance, notably in poliomyelitis and spastic paralysis. In the former it is due to weakness of the dorsiflexors of the foot, when the plantar flexors are functioning. In a flail limb it may be due to the action of gravity. In spastic paralysis it is due to spasm of the calf-muscles and contracture of the tendo-achilles.

Drop-foot may be due to injury to the external popliteal nerve which may be pressed upon by tight bandages, splints or plasters, or the nerve may be damaged during injury to the knee-joint. Other causes include injury or disease of the ankle joint.

Treatment depends upon the cause. Postural and paralytic drop-foot requires support in a club-foot shoe or plaster shell, with the foot at a right-angle. Physiotherapy is employed to re-educate weak muscles and to stretch contracted ones, and to restore muscle balance.

Contracture of the tendo-achilles may require fixation in successive plasters to overcome the deformity.

Method of application. The patient lies on a table, an assistant grasps the knee, protecting it from strain and *maintaining it in right-angled flexion*. The limb is covered with wool-roll, the foot grasped in both hands and pushed into as much dorsiflexion as the patient can stand. The plaster is then applied in the usual way.

The following important points should be noted:—

(1) The foot must be in neutral rotation, neither in varus nor in valgus.

(2) Correction must take place at the ankle-joint, not at the mid-tarsal joint.

(3) The knee remains flexed to the right-angle. The plaster is applied below the knee first; when it has set firmly slowly straighten the knee and incorporate it in the plaster. A few turns of wool roll at the junction of the upper and lower portions of the plaster will prevent pressure sores.

The plasters are changed at weekly intervals until full correction is obtained.

If conservative measures fail open or subcutaneous elongation of tendo-achilles may be performed.

Permanent drop-foot requires a double iron with posterior stops, with plaster shell for night wear

Operative treatment may consist of tendon transplants or certain forms of stabilisation

PES CAVUS (Claw foot)

Claw foot is a deformity in which there is exaggeration of the longitudinal arch of the foot dropping of the metatarsal heads, and clawing of the toes. (Fig 84) Idiopathic claw foot is the most common, but it may be associated with diseases of the



Fig 84.
Claw foot. (*Farquharson*)

nervous system such as poliomyelitis or Friedreich's ataxia when the intrinsic foot muscles are weakened Claw foot sometimes follows disease or injury of the bones of the foot.

Clinical features. The patient tires easily and the gait is clumsy Painful callosities form beneath the dropped metatarsal heads, and corns appear on the interphalangeal joints of the clawed toes. On dorsiflexing the foot the tight plantar fascia can be seen and felt.

Treatment. Conservative treatment in mild cases consists of a metatarsal bar to the shoe manual stretching and foot exercises.

Operative treatment Numerous operations are employed, often in combination.

(1) Tenotomy of the plantar fascia and wrenching followed by plaster fixation for four months. Weight-bearing in plaster is allowed in a few days. Foot exercises are commenced on removal of plaster and a metatarsal bar is sometimes ordered.

(2) Correction of clawing of the toes by tenotomy of the extensor tendons, plaster fixation for six or eight weeks.

(3) Arthrodesis of the proximal interphalangeal joints of all the toes plaster fixation for six or eight weeks.

(4) In later life, correction can be obtained only by bone resection, for example, some form of stabilisation. In extreme cases, amputation of all the toes or of the foot itself may be advised



Fig 85.
Paralyt calcaneo cavus def rmity of the left foot.

TALIPES CALCANEUS (Long heel)

This is a deformity in which the tendo-achillis is lengthened, so that the heel is at a lower level than the forefoot It is sometimes combined with a cavus deformity (Fig 85) Causes in clude poliomyelitis affecting the calf muscles, stretching of the tendo-achillis from any cause or injury to the tendo-achillis in childhood.

Treatment Conservative treatment consists of a heel elevator (a piece of cork or sorbo-rubber is inserted inside the heel of the shoe) and exercises.

Operative treatment may consist of the transplantation of active muscles to the tendo-achillis this is often combined with stabilisation of the foot

TALIPES VARUS

This is a deformity in which there is inversion of the foot. It is due to muscle imbalance as in poliomyelitis, when the evertors are paralysed and the invertors functioning normally. In spastic paralysis it is due to spasm of the invertors. Other causes include disease or injury of the bones of the ankle or foot.

Treatment. Conservative treatment may be —

(a) Plaster fixation in the corrected position.

(b) Inside iron, outside T-strap.

(c) Physiotherapy to restore muscle balance.

Operative treatment may consist of transplantation of tendons from the inner to the outer side of the foot, or some form of stabilisation.

METATARSUS VARUS

This is a deformity in which there is adduction of the forefoot at the mid-tarsal joint (Fig. 86).

Treatment consists of wearing the right shoe on the left foot and vice versa. The shoe may be raised on the outer side of the heel; when the shoes are worn on opposite feet this brings the raising to the inner side. Correction by moulding in successive plasters is sometimes advised.



Fig. 86.
Metatarsus varus.

METATARSALGIA

Metatarsalgia is the name given to a pain experienced under the metatarsal heads. In many cases it is due to weakness of the intrinsic foot muscles, and may be combined with foot-strain; painful callosities develop under the metatarsal heads and the toes are sometimes clawed. In Morton's metatarsalgia there is lancinating pain between the third and fourth toes and the condition is then due to a neuroma of the interdigital nerve.

Treatment consists of intensive foot exercises to strengthen

the intrinsic muscles, combined with some device to relieve the weight taken by the metatarsal heads. This may consist of a pad of white felt placed behind the metatarsal heads and retained by strapping as shown in Fig 87 Alternatively an



Fig 8
Felt pad and strapping applied for metatarsalgia.
(*F rqaharso*)

insole with metatarsal bar or button may be advised, or a metatarsal bar attached to the shoe itself. (Fig 55) Experiment may be necessary to determine the exact situation of the bar or button and rational foot wear is essential.

Morton's metatarsalgia requires removal of the neuroma between the third and fourth toes.

CHAPTER IX

TUBERCULOSIS OF BONES AND JOINTS

Mode of infection. Changes in infected joints. Diagnosis of tuberculosis. General symptoms and signs. Local symptoms and signs. Aims of treatment. General treatment. Complications.

TUBERCULOSIS of bones and joints is caused by the invasion of the body by Koch's bacillus, and occurs most frequently in childhood. It is influenced by economic and hereditary factors, in that bad living conditions resulting in a low state of general health predispose the subject to tuberculosis, and overcrowded dwellings encourage its spread. In many cases there is a family history of tuberculosis. The invading organism may be one of two types:—

(1) *Human* type, which is acquired by inhalation from persons suffering from tuberculosis of the lung.

(2) *Bovine* type, which is ingested in milk from infected cows. The infection spreads via the lymph vessels and blood stream; lymph glands become infected, and may send showers of organisms into the lymph and blood streams from time to time. In joints, the local lesion frequently commences in the synovial membrane, especially near its reflection from bone. In many cases, there is a history of injury producing a haematoma, which is the ideal breeding ground for invading organisms. In children, if the resistance is high and treatment efficient and prolonged, the lesion may remain synovial only.

The local reaction of tissue to the presence of tuberculous bacilli is known as a *tubercule* or *tuberculous follicle*. This is seen microscopically to consist of lymphocytes surrounding clumps of bacilli, and a typical feature is the presence of a giant cell. Toxins are liberated by the bacilli which destroy the protective cells; in this process, which is called caseation, the damaged cells soften and liquefy, and as the disease progresses, various tuberculous follicles fuse together in a cheesy mass, which may become obvious as a "cold abscess." Further changes depend on the virulence of the infection and the degree of resistance of the individual. If the progress of the disease

is arrested, fibrous tissue is laid down, which eventually walls off the disease and healing takes place calcification in abscess walls often marking its site permanently

Changes which occur in affected joints. The synovial membrane becomes thickened and the synovial fluid increased in amount. The cartilage becomes dull, disintegrated and eroded, and may become separated from the bone. The bone at and around the lesion becomes decalcified, due to the increased blood-supply and appears less dense than normal bone on X ray examination. As the disease progresses there is erosion and destruction of bone, with the formation of cavities, and sometimes, sequestra (fragments of dead bone). The soft tissues undergo degenerative changes. Ligaments and tendons become swollen stretched and lax, muscles atrophy and cold abscesses may appear as fluctuant swellings.

The diagnosis of tuberculosis is made from the following points —

(1) History

(2) Clinical signs.

(3) X ray signs.

(4) Skin tests, e g Mantoux test.

(5) The presence of tuberculous bacilli in pus, if obtainable.

(6) The presence of tuberculous glands in the abdomen of a guinea pig killed six weeks after it has been injected with suspected pus This is the most sensitive test, but suspected early cases are diagnosed and treated on clinical grounds alone even in the absence of X ray and other signs.

(7) In some cases, biopsy of synovial membrane or of neighbouring lymph glands may help to establish the diagnosis.

General symptoms and signs of tuberculosis of joints. The patient is pale and listless, and does not enjoy his work or play He is tired on slight exertion and there may be marked loss of appetite and loss of weight There may be rise of temperature in the evenings, with night sweats and disturbed sleep.

Local symptoms and signs. There may be aching pain, sometimes referred to neighbouring parts, swelling, local heat

and local tenderness on palpation. There may be protective muscle spasm around the part and later muscle wasting from disuse. Movements of an affected joint are limited in all directions and deformity may be present.

Aims of treatment. (1) *To save life.* (2) *To induce healing of the diseased part in the best possible functional position.* These aims are achieved by (1) *general treatment*, including the provision of conditions under which the patient's resistance can overcome the disease and (2) *local treatment*, which consists of rest of the affected part. Most cases of joint tuberculosis require prolonged treatment in hospital, sometimes for several years.

General treatment. The importance of efficient general treatment cannot be too heavily stressed and *it is particularly important for the nurse to remember that the lesion in bone is only a local manifestation of a generalised tuberculous infection.* It is useless to splint a patient's limb because he has a tuberculous joint if the state of his general health is ignored, or if he remains in the surroundings which predisposed him to the disease. The general treatment outlined here applies to *all* cases of tuberculosis of bone, no matter how trivial the local lesion may seem. A tuberculous wrist may seem a minor condition to the uninitiated, but it is none the less a local manifestation of a deadly generalised infection.

(1) **Fresh air.** This is absolutely essential. The patient should be nursed out of doors *at all times*. He should sleep in a ward which is completely open down one side and should be exposed to *all* changes of weather except actual rain, snow or *direct* sunlight. Exposure to changes of wind and weather improves the appetite, stimulates metabolism, increases the patient's powers of resistance and promotes a sense of well being. *The early morning air is especially beneficial.*

(2) **Sunshine in moderation.** Sun baths, properly supervised and regulated, are [illegible] but a word of warning is necessary. Exposure to *dir*[illegible] sunlight causes loss of body fluid and may result in [illegible]. It produces, not a sense of well being [illegible] and painful sunburn, and may [illegible] tuberculous lesion. The

patient whose lesion is active or who is still febrile should never be exposed to the sun, except in the early morning or evening *never* at mid-day This is especially important in the case of children, whose skins are delicate who quickly become dehydrated, and who will bake uncomplainingly if left to do so by a careless nurse

(3) **Liberal diet.** Food must be adequate, well cooked, varied and pleasantly served. Fruit and vegetables are important and extra fats are necessary in winter to help the patient withstand exposure to cold weather The nurse must *not allow a patient rendered helpless by his splintage to struggle* ineffectually with his food. She must report any patient refusing food and must exercise charm and tact in feeding children and old people.

(4) **Fluids.** All tuberculous patients require extra fluids in order to maintain adequate urinary output and thereby diminish the risk of renal stones. The nurse will explain to the adult patient the necessity for taking more fluid than he wants, and gently insist on it in the case of a child.

(5) **Cleanliness.** The nurse must realise the importance of this in her patient herself and her surroundings. The tubercle bacillus, like all other organisms, thrives in dust and dirt Hair teeth and nails must be kept clean, and nurses *should encourage patients to take an interest in their* appearance.

(6) **Warmth.** These patients develop a high resistance to cold, but bed-clothes and personal clothing should be adequate for the time of the year Hot water bottles are necessary in winter

(7) ***Treatment of co-existing disease.*** Tuberculous patients usually have a chest X ray on admission Septic foci such as may be present in the teeth or tonsils, or indeed any condition which may retard the patient's recovery are investigated and treated The observant nurse will report anything she considers abnormal to the ward sister

(8) ***A happy atmosphere,*** freedom from anxiety and occupation for the hands and mind (see Chap II) These are

obviously of paramount importance to the patient who must spend many months in hospital

(9) **Streptomycin therapy** This would appear to be most successful in early cases, and in those in which soft tissues only are chiefly involved for example in synovial tuberculosis of the hip or the knee Its full usefulness, however has yet to be proved and it will always be only an adjunct to correct orthopaedic treatment

Complications of tuberculosis of joints

The following complications may occur in *any* case of tuberculosis. Special complications for each region will be enumerated later

(1) **Deformity** of the affected part This may be due to protective muscle spasm, destruction of bone or ankylosis of joints, and can be seen on examination.

(2) **Abscess formation.** When the tubercle bacillus invades the body it is immediately assailed by the special cells in the blood-stream whose function it is to combat infection (i.e. the lymphocytes) The battle which ensues causes the formation of pus, containing dead and dying bacteria and dead or dying blood and tissue cells. If the invading organism is of such a virulent nature as to set up a severe systemic reaction (as for example in acute osteomyelitis) pus is formed in large quantities and quickly comes to the surface as an abscess. In most cases of tuberculosis, however the battle is slow and sustained and the formation of pus may give rise to little or no systemic reaction. Such a collection of pus is spoken of as a cold abscess It may remain adjacent to the affected bone or taking always the line of least resistance through the surrounding tissues, track to the skin and appear as a fluctuant swelling Abscess formation is often quite symptomless, or it may be indicated by pain, rise of temperature loss of appetite disturbed sleep and finally by the appearance of a fluctuant swelling which may be at a very great distance from the site of the disease The pus is evacuated by repeated aspiration through healthy skin under strictly aseptic conditions This is to prevent the abscess breaking down and the formation of sinuses.

Incision and drainage of an abscess may be carried out in certain selected cases.

(3) **Sinus formation.** In many cases the skin over an abscess becomes so thin, reddened and devitalized that it yields and breaks down in spite of repeated aspirations, and a passage between the skin and the deeper tissues appears. A sinus must be dressed with meticulous care and aseptic precautions always observed, no matter how small and innocuous a wound it may appear. *Dressings should be changed as infrequently as possible.* One carelessly applied dressing will be sufficient to introduce other micro-organisms into the wound, so that the patient has two infections to combat instead of one. This may result in a severe general illness, and the condition may become chronic with the attendant evils of long continued sepsis.

(4) **Amyloid disease.** In cases of long-standing and particularly in those where there are multiple sinuses and long continued sepsis, *waxy deposits are laid down in the vital organs* (for example, the liver kidneys spleen and intestines). This results in a gradual replacement of vital cells by lardaceous material, *with consequent slowing-down of* metabolic processes and a gradual decline in the patient s general condition. Discharging sinuses result in loss of albumin and plasma protein, resulting in oedema There may be periodic vomiting diarrhoea alternating with constipation, and albuminuria. There is progressive loss of weight the skin becomes yellow and dry and the features haggard and drawn. The patient may live for months in an emaciated, exhausted state until death supervenes. Meticulous dressing of sinuses from the moment they appear the maintenance of a very high level of general health and a high protein diet will do much to prevent such miserable and lingering deaths. Concentrated plasma may be given intravenously and in suitable cases (e.g the ankle) amputation of the affected limb may be performed.

(5) **Tuberculosis of other parts** (other than the primary lymphatic infection) This is a common complication, as the bacilli are carried all over the body by the blood and lymph stream The part attacked may be another joint the lung, the kidney or the mastoid cells. Such lesions may be manifested by pain in another joint by rise of temperature, by cough, by

urinary symptoms or by digestive upsets, according to the part attacked. Any indication of a tuberculous lesion elsewhere must be promptly reported and dealt with.

(6) **Deformity of other parts.** These are most commonly due to bad nursing and will be enumerated later.

(7) **Renal complications.** When bone is decalcified and destroyed by disease the liberated calcium salts are eliminated by the kidneys. Prolonged fixation in the lying position prevents adequate drainage of the kidneys, and this, combined with insufficient fluid intake results in the retention of salts within the renal pelvis. This may lead to the formation of stones, which predispose the urinary tract to infection. The urine must be tested at regular intervals as changes in its composition (e.g. the presence of albumin) may indicate urinary complications. If this is suspected, a fluid intake and output chart must be kept and it will be necessary to obtain a sterile specimen of urine for bacteriological examination. Elevating the head and foot of the bed alternately for short periods assists in drainage of the kidneys, or frequent change of position in those cases in which it is not injurious.

Renal complications may be (1) Renal stones. (2) Renal colic. (3) Renal infection.

(1) *Renal stones* may be symptomless, or there may be haematuria on turning.

Treatment. (a) Frequent change of position (e.g. turning) within the limits of correct orthopaedic treatment. (b) Copious fluids. (c) Surgical intervention.

(2) *Renal colic.* The passage of a stone down the ureter may produce renal colic with vomiting, pain in the loin or abdomen or referred to the groin, the testicles or the labia. Albumen and blood is found in the urine.

Treatment. (a) Morphia and Atropine or Pethedine is ordered for the relief of pain, with attention to the general comfort. (b) Surgical intervention.

(3) *Renal infection.* This may be either (a) pyelitis, an inflammatory condition of the renal pelvis, or (b) pyonephritis, in which the kidney substance is involved. The infection may be blood-borne or it may ascend from the bladder and is com

monly associated with renal stasis. It is indicated by the following *general symptoms*— malaise pyrexia, headache and vomiting The *local symptoms are*—Pain in the loin, frequency of micturition, and burning pain on micturition which is referred to the urethra. The urine contains pus and organisms.

Treatment Medical treatment which includes the administration of drugs, fluids, and dietary measures as ordered by the physician.

(8) **Pott's paraplegia.** This is a complication of tuberculosis of the spine and will be described under that heading

(9) **Tuberculous meningitis.** This may be characterised in the prodomal stage by loss of appetite apathy and general loss of interest in life There is then severe headache, restlessness, neck rigidity and intolerance to light with pyrexia, vomiting and sometimes, delirium. The patient finally relapses into unconsciousness, and death supervenes. *Streptomycin* is usually ordered, and in cases diagnosed early holds out hope of recovery

(10) **General miliary tuberculosis.** The patient's body becomes the seat of multiple virulent tuberculous lesions, manifested by any or all of the signs and symptoms previously enumerated, and death supervenes

CHAPTER X

TUBERCULOSIS OF THE SPINE

(POTT'S DISEASE)

Symptoms and signs. Treatment. Splintage for different regions of the spine. Immobilisation on a Thomas' straight frame. Immediate nursing care. *Daily nursing care. Daily care of splintage.* **Turning. Protection of a kyphos. Maintenance of correct position on a frame. Prevention and correction of deformity. Summary of sequelae associated with prolonged immobilisation. Management during X-ray examination. Nursing care of a patient in a plaster bed. Special nursing points of tuberculosis of particular regions of the spine. Pott's paraplegia. Splintage. Application of club foot shoes. Daily nursing care. Later treatment for tuberculosis of the spine. Conservative treatment including splintage for different regions. Application of a Jones' spinal support. Daily nursing care. Treatment of pressure sores. Application of block leather or celluloid jacket. Daily nursing care. Operative treatment. Preparation for a spinal operation. Post-operative nursing care.**

THE spine is more often attacked by tuberculosis than any single joint. The *vertebral bodies in the dorso-lumbar region* are most frequently affected because it is in this region that most weight is borne and most movement takes place. The vertebral body becomes eroded, and collapse occurs due to muscle-spasm and weight bearing on diseased bone. This is always marked in the dorsal region as owing to the normal backward *convexity of the spine in this area most weight is thrown on the* front of the bodies, predisposing them to collapse. In cervical and lumbar caries, collapse is never so marked as the spine is convex forward in these areas and weight is borne chiefly on the articular processes and the back of the bodies respectively.

Symptoms and signs of tuberculous disease in particular regions of the spine

The general symptoms and signs are set out in the previous chapter.

(1) **Cervical region.** The patient will walk carefully with short steps, and if the condition is advanced he *may support his* head in his hands. There is limitation of neck movement in all directions. Pain will be present sometimes referred to the top

of the head. There will be loss of the normal forward cervical curve and swelling denoting an abscess may be palpated in the suboccipital region, or a retropharyngeal abscess may be present. If the condition is far advanced, there may be signs of cord pressure varying from exaggerated reflexes to actual spastic or flaccid paralysis. The arms will be affected first and the legs follow.

Dorsal region. The spine is held stiffly, the gait is erect and careful, and the patient dislikes sitting. Spasm of the erector spinae muscle may be visible. Collapse of the affected vertebral bodies will cause the spinous processes to protrude

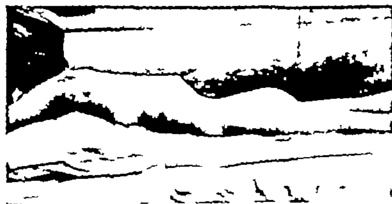


Fig. 88.
Kyphos due to collapse of vertebral bodies in tuberculous disease of the lower dorsal spine.

causing a bony projection called a kyphos or gibbus. (Fig. 88.) This is frequently the first thing to be noticed. The kyphos may be tender on palpation and hot to the touch. Pain may be referred around the chest wall (girdle pains) or may be described as aching in character. There may be fullness or swelling in the loins or along the ribs indicating an abscess, though as a rule tuberculous abscesses in this region remain peri-spinal and do not escape to the skin. It is because of this that paraplegia is most common in dorsal lesions. In early cases cord pressure may be indicated by ataxic gait and exaggerated tendon-reflexes, and later paralysis of the legs may occur. In the most advanced cases sensory changes may be present below the lesion.

Lumbar region. There is rigidity a careful gait and the patient will not stoop Pain radiates down the legs and there may be flexion of the hips due to spasm of the psoas muscle Kyphos is not often marked, but there is obliteration of the normal lumbar lordosis. There may be abscess formation in the loin, or the abscess may track down the sheath of the psoas muscle and appear in the groin or in front of the thigh. A psoas abscess is the most common complication of tuberculous disease of this area.

X ray examination is carried out in all cases. It may reveal diminution of the joint-space between two adjacent vertebrae or evidence of bony destruction.



Fig 89
Plaster bed used in a case of tuberculosis of the spine with large angular kyphos in the lower dorsal region.

Treatment. (1) *General treatment* as already described. (2) *Local treatment* i.e. rest of the affected part

Splintage is applied according to the part affected and each case is considered individually All splintage described here is subject to variations according to the surgeon s wishes, the age build, and general condition of the patient and his particular lesion. Children require more stringent immobilisation than adults because of their greater activity Immobilisation is carried out by means of a *Thomas straight frame* or a *plaster bed*

Advantages of a frame over a plaster bed It is comfortable if well fitting, easy to lift without disturbing fixation it allows the maximum of sun and air to reach the body and facilitates

examination of the patient. It can be kept in stock and used for other patients.

Advantages of a plaster bed. This is cheap and comfortable and is made to fit the individual patient and is therefore indicated if there is gross deformity (e.g. marked kyphos) or if the patient is excessively thin, fat, old or frail. It is more cumbersome than a frame as it is mounted on a wooden support (Fig 89) but it is probably more fool-proof and nursing is somewhat easier.

Splintage for different regions of the spine. (1) *Cervical region (first to seventh cervical vertebrae)*

(a) A straight frame with saddle, sunken headpiece collar and brow band. (b) A plaster bed with sunken headpiece collar and brow-band.

(2) *Upper dorsal region (above the sixth dorsal vertebra)* (a) A straight frame with sunken headpiece and collar (b) A plaster bed with sunken headpiece and collar

N.B. In all lesions of the cervical or high dorsal region, a tilting mirror must be fixed to the bed. (Fig 108.)

Mid-dorsal region (between the sixth and ninth dorsal vertebrae) (a) A straight frame with a sunken headpiece, no pillow allowed. (b) A plaster bed with a sunken headpiece no pillow allowed.

Lower dorsal region (between the ninth and twelfth dorsal vertebrae) (a) A straight frame with straight headpiece, one pillow allowed. (b) A plaster bed with one pillow. Groin straps or a pelvic band should be applied if the patient is young and lively.

(3) *Lumbar and sacral region* (a) A straight frame with or without headpiece in conjunction with a pelvic band or two groin straps. A pillow is allowed. (b) A plaster bed with pelvic band or groin straps incorporated. *In a child, a straight or sunken headpiece is always required* regardless of the site of the lesion, in order to prevent him from slipping up the frame.

An anterior plaster shell in which the patient is turned is made in all cases. The method of measuring for a frame and of making a plaster bed and a turning case is described elsewhere (Chaps. IV and V.)

To immobilise a patient on a Thomas' straight frame

(1) **Preparation of the patient.** Explain to the patient what is about to be done and reassure him. Nervous individuals may require sedation for a few days prior to fixation. The patient must be immaculately clean, and if a sunken headpiece is ordered the hair should be cut short The bowels should be regulated, and an enema is given before immobilisation. This helps to prevent frame sickness, by putting the bowel at rest. Never place a patient on a frame or plaster bed in the evening unless absolutely essential

(2) **Preparation of the frame.** Remove the saddle and guards. Bind all metal surfaces with strips of old linen to protect the bedclothes. Pad the ankle crutches with splint wool covered with a gauze bandage Tie a calico bandage in a clove-hitch to the centre of the upper cross-bar and thread it through the shoulder guards. If a headpiece is used cover the screws with a little wool and strapping to prevent them from becoming loose Place the saddle in position on the frame but do not tie it on. Prepare a tray containing cotton bandages for the legs, splint wool and felt for padding, and a Lucas wrench for adjusting the nipple and pelvic bars

Procedure. Undress the patient keeping him covered with a blanket and see that he is lying straight. Four or five assistants are necessary depending on the size of the patient In a cervical lesion one nurse must support the head throughout. Nurse 1 will place the frame under the patient while Nurses 2, 3 and 4 lift Nurse 1 takes up her position at the side of the bed, holding the frame with saddle in position, opposite to the patient. Nurse 2 stands at the top of the bed, and instructs the patient to clasp his hands behind the back of his neck. She then grasps him under the scapulae and the patient's flexed elbows are pressed against her forearms. Nurse 3 stands at the side of the bed facing the patient and grasps the pelvis firmly Nurse 4 stands at the foot of the bed, supporting the legs just below the knees. (Fig 90) At the command given by Nurse 1 "one two, three lift" the patient is quickly and smoothly raised all in one piece Nurse 1 slips the frame into position and the patient is lowered on to it.



Fig 90.
First stage in immobilisation, showing correct method of lifting the patient on to the frame.



Fig 91.
Second stage in immobilisation. The patient is lifted to each side of the bed while the bars re kinked to fit the body and the saddle is tied to the frame.

Nurse 1 now proceeds to satisfy herself on the following points —

(1) The patient is in correct position on the saddle i e the tip of the coccyx approximates to the fork of saddle

(2) The buttocks lie equally in the fork of saddle

(3) The saddle supports the shoulders as far as the seventh cervical vertebrae and extends to the level of the head of the tibia. If it extends below this level, it will press on the calf muscles and cause them to waste

(4) The patient and saddle are in correct position on the frame i.e. that the ischial tuberosity fits into the gluteal bend of the frame



Fig 92.
Third stage in immobilisation. Wool packing is placed beneath the knee so that it is flexed 5 The knee bandages have not yet been applied. Note that the knock knee bars lie parallel to the long axis of the lower limbs (See also Fig 93.)

(5) The head fits snugly into the headpiece.

(6) The neck is supported.

(7) The ankles are comfortably supported by the crutches.

Next, the frame is lifted to first one and then the other side of the bed and the nipple and pelvic bars are kinked with a Lucas wrench so that they embrace the body closely and the saddle ties are securely fastened at the same time (Fig 91) It is essential that the pelvic bars are closely moulded, so as to prevent lateral movement of the spine The nipple bars should be just sufficiently tight to allow full respiration Cross the shoulder ties, and fasten by threading them through the openings on the nipple bars and tie them in a bow They should be firm, but must not press into the patient s neck. Cover the patient with a blanket except for the legs Fold a piece of felt into a

square and place behind the head of the tibia. Supplement this with folded splint wool, then graduate splint wool packing down the entire length of the leg below the knee so that the thigh is supported by the saddle in the neutral position and the knee is comfortably flexed. (Fig. 92.)

Adjust the knock bars with a wrench, if necessary. It is essential that they fit closely in the long axis of the leg to prevent knock knee. Place a block under the cross-bar to raise the frame, and proceed to bandage the legs. Be sure that the patella is in mid line. Cover the limb with wool and start to bandage from without in; take the end of the bandage round the knock-knee bar, then continue round the limb. In adults, the bandage should cover the knee only, but in children it is necessary to bandage the entire length of the limb. In very lively children it is better to start bandaging by taking a few turns round the knee and saddle only, continuing round the knock-knee bar. Bandaging should be firm, even, and tight enough to hold the leg comfortably, but not tight enough to press on the quadriceps muscle and cause it to waste. Secure the end of the bandage neatly with a safety pin. Next see that no day light is visible between the back of the neck and the headpiece. If this is so, make a "sausage" by stuffing a piece of tubular stockinette with splint wool. Thread a gauze bandage through the "sausage," slip it beneath the neck and tie it behind the headpiece. If a sunken headpiece is used, it will be necessary to support the frame on three wooden blocks placed under the shoulders, the hips and the cross-bar. The headpiece and the heels will then be clear of the bed. The block under the hips is to prevent sagging of the frame and saddle at this point. In cases where a sunken headpiece is not used, the frame is placed directly on to the bed. Replace the patient's clothing and make the bed, first placing a cradle in position to keep the weight of the bedclothes off the feet. See that the heels do not press into the bed. A pillow under each arm adds to the patient's comfort. Leave the patient warm and comfortable.

Clothing. Ordinary night wear is unsuitable, as putting it on involves undesirable movement of the spine. Nightgowns, shirts and jerseys must either be large enough to be worn over the frame or split down the back and fastened with tapes or buttons.

Immediate nursing care

Children take very kindly to frame fixation and as a rule suffer no ill-effects. Adults, on the other hand, find it a great ordeal. The lying position puts the abdominal muscles on the stretch and gives rise to nausea and vomiting. This is known as **frame-sickness**, a dangerous condition which has been known to result in death. *Every effort must be made to prevent* its occurrence by correct preparation of the patient and by ensuring warmth, quiet, adequate sleep, a light diet and evacuation of the bowels during the early stages of fixation. Should vomiting commence it is reported to the surgeon at once and sips of water and glucose only should be given. The knee-bandages are removed and the knees are flexed on pillows to relieve the abdominal stretch. If vomiting persists, saline is given either rectally or intravenously and severe cases may require continuous gastric suction. When the condition has subsided, flexion of the knees is gradually reduced until the patient can tolerate the desired position.

Retention of urine. The nurse must observe and report whether or not the patient succeeds in passing urine naturally. The administration of copious fluids, warmth and privacy will as a rule suffice to enable the patient to pass urine. Diuretics may be ordered, or parasympathetic stimulants of the acetylcholine group. As a last resort catheterisation must be carried out.

Constipation commonly follows frame fixation due to the cessation of activity and to the new position. This should be prevented by the administration of copious fluids and fresh fruit and vegetables. Liquid Paraffin may be given and should an evacuation of the bowels not occur in forty-eight hours, a simple enema is less distressing to the patient than drastic purgatives. The nurse must encourage the patient in regular habits by giving bedpans at the same time each day.

Pain. This is most often felt in the small of the back, and is due to the "settling" of the lumbar spine on to the saddle. It may also be felt down the front of the thigh if there is contracture of the hip flexors. It is usually of short duration, and warmth, sedatives and attention to the general comfort will

alleviate it. The nurse must never place pillows, pieces of wool or other material between the patient's back and the saddle.

If the patient's condition is such that he is unable to feed or wash himself, these offices must be performed for him at the discretion of the sister in charge. Once the patient has settled down and become reconciled to frame fixation, he usually prefers to do these things for himself, but the nurse must satisfy herself at all times that the necessary materials for meals or for the toilet are within the patient's reach.

Daily nursing care

The general nursing care as previously set out must be faithfully carried out in all cases. The nurse must learn truly to observe her patient and to report if he shows any signs of deterioration in his general condition.

Daily toilet. Prepare a tray with necessary washing materials and take it to the patient's bed. If the patient is able to wash himself, allow him to do so under supervision. No patient with a lesion of the cervical spine or of the dorsal region above the sixth dorsal vertebra should be allowed to wash himself other than the face and hands. In the case of children, all exposed surfaces should be washed at least once each day, and in adults at least three times weekly. If a collar is worn, remove it for washing the neck, but do not lift the head out of the headpiece.

The nipple and pelvic bars may be loosened for washing the chest and abdomen. Using a flannel and towel kept specially for the purpose, wash the external genitalia without exposing the patient unnecessarily. If groin straps are worn, pay special attention to the areas beneath them. Unless the fixation is so stringent as absolutely to preclude it, adolescent boys and men should be given the opportunity of washing themselves under cover of the bedclothes, the nurse handing flannel and towel in turn. The anal region, however, cannot be reached by the patient and should be washed each time a bedpan is used. As much of the saddle as can be reached should be rubbed with a fairly dry, well soaped flannel at the same time. It is vital that particular attention is paid to cleanliness of the external genitalia in female patients. Neglect may result in either

urethral infection (usually bacillus coli) which may later cause cystitis, or an offensive vaginal discharge. If anything of this nature is noticed, it should be reported at once.

N.B. Treatment of the skin of the back, except when the patient is turned, is both unnecessary and harmful. It involves undesirable movement. In the writer's experience pressure sores on the back never occur except in the following circumstances —

(a) When there is an *unprotected* kyphos: protection is discussed later; and a plaster bed must be used in cases of gross deformity.

(b) When the frame is so ill fitting as to allow the patient to slip about on the saddle, producing sores from friction.

(c) When the saddle is old, cracked, dirty and misshapen. Do not attempt to economise in saddles. It is better to order a new one from time to time than to allow the patient to develop sores. Only those saddles which are perfectly smooth and shapely should be kept in stock for use in emergencies.

(d) When urine and faeces is allowed to track up the saddle. This may produce a sore on the buttock, or even on the sacrum. If it occurs, it is a grave reflection on the nurse as it indicates that bedpans are carelessly given and that the toilet after their use is neglected. It is essential that the patient is cleaned, washed and dried after each bedpan and urinals should be used for females as well as males. (Fig. 94.)

Daily care of splintage. When the toilet is complete the nurse must satisfy herself that the patient is comfortable and in correct position on the frame. Place the fingers on the tip of the coccyx and see that it exactly approximates to the fork of the saddle. If it is above the saddle this will become contaminated with faeces; if below, the buttocks are unsupported and become swollen and indurated; see that the buttocks lie equally on the saddle. Inspect the nipple-bars: these should be tight but not tight enough to impede respiration, and they should not press into the patient's body. See that they do not impede the patient's view or prevent him balancing objects (e.g. a book or writing pad) on his chest. If this is so, they are either too long or incorrectly moulded. Examine the chest,

abdomen and thighs for swelling. See that the anterior superior iliac spines are level and that the hips are held in extension. Inspect the pelvic bars, see that they fit snugly without causing pressure. The bars will require re-kinking and adjusting from time to time and must be kept well fitting. If groin straps are worn, *see that they fit firmly and comfortably without* pressure. Next inspect the knee bandages. In an adult patient it may not be necessary to adjust these every day but in children daily re-application is usually needed. Place a block under the cross-bar and remove the bandages, rolling them up tidily. Do not allow them to trail on the floor. Inspect the limbs for signs of pressure, swelling or deformity. Make sure there is full movement of the feet but do not encourage dorsiflexion beyond the right angle as this produces calcaneous deformity of the feet and *hyperextension of the knees, due to constant stretching of the* calf muscles. Foot exercises will be given by a physiotherapist. It is vital that sufficient padding is placed under the knee to prevent hyperextension, especially in children, whose muscles and ligaments are lax. ***The knee must be comfortably supported in slight flexion at all times.*** Padding should be under the head of the tibia as it is this bone which becomes displaced backwards. Padding under the lower end of the femur will not prevent hyperextension and it may lead to flexion contracture *of the hip. Always bandage the knees over splint wool.* Make sure the patella is in midline and bandage as previously described. Place the cradle in position, make the bed and leave the patient comfortable with his locker and belongings within reach.

To give a bedpan to a patient on a frame. Aluminium pie-dishes are to be preferred to the ordinary type of bedpan. Screen the bed (unless a bedpan round is being done when the ward will be closed) and carry the covered bedpan to the patient's bed. *A urinal is also given.* Adult patients on frames are usually nursed on mattresses which have a removable section, leaving a space under the frame in which the bedpan is placed. (Fig. 93.) Remove the section, but do not put it on the floor; place the bedpan in position, cover the patient and leave him. Adult patients usually advise the nurse as to the exact position of the bedpan. When the bedpan has been used, clean the patient thoroughly with toilet paper wrapped

round the fingers. *In females this must always be done in a downward direction* so that faeces are not introduced into the vagina or urethra. Remove the bedpan wash the patient s anal region, and leave him clean, dry and comfortable No patient must be left indefinitely on a bedpan, as this leaves the hips unsupported and the frame will gradually yield to the patient s weight and a flexion contracture of the hips will follow Children are not as a rule nursed on a section mattress To give

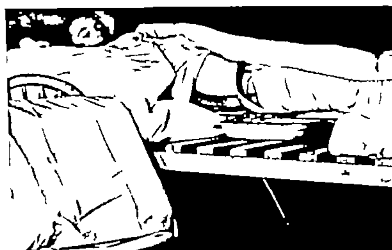


Fig 93.
Showing section of mattress removed fo placing a bedpan under a patient on a frame.

a bedpan, raise the frame by the nipple bars and slip the bedpan into position. Raise the head and shoulders on a block. Clean and wash in the same way

Importance of the use of a urinal in female patients. It is advisable to teach and encourage all female patients on frames to use a urinal of some kind. Experiment will determine the type of urinal most suited to the individual patient Long necked pickle jars or jam jars can be used for patients who find the ordinary type of urinal unmanageable Most patients, even quite small girls, can be taught to hold the urinal for themselves, but if splintage precludes this, the nurse will find that she is amply repaid for her time and trouble in holding the urinal by

the increased comfort and cleanliness of the patient, and of her frame and bedding. (Fig 94.)

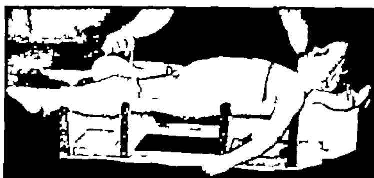


Fig. 94

It is essential that a urinal is used by patients of both sexes to prevent contamination of splintage This illustration shows a urinal being given to a patient on a plaster bed, which is even more readily soiled than a frame and saddle. This little girl became expert at holding a urinal herself

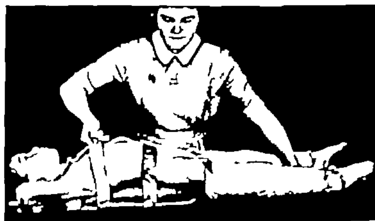


Fig 95

The method of lifting a patient on a straight frame This illustration also shows the knee bandages applied.

To lift a patient on a straight frame. A child can easily be lifted by one nurse grasping the nipple bars in one hand and the cross-bar in the other (Fig 95) A heavier patient requires two nurses, one lifting by the nipple bars and the other grasping the knock knee bars.

Hair washing If the lesion is above the ninth dorsal vertebra the hair must not be washed except when the patient is turned It should be cut short at the back if a sunken head piece is used, as in any case it will be worn off from constant contact with the headpiece Enough should be left in front to satisfy the patient's vanity In lesions below this level or in any case where a headpiece is not indicated the patient can safely be brought to the end of the bed and the hair washed by the accepted method.

Turning All cases of tuberculosis of the spine are turned from time to time to allow of the following procedures —(1) Inspection and treatment of the back (2) For hair washing and attention to the general cleanliness.

It is not possible to lay down the law as to how often a patient should be turned *it is left to the discretion of the ward sister who is conversant with the individual needs of each of her patients*, but the general rule should be not more often than necessary and no patient should be turned just because it's Thursday Regular and frequent turning is, however essential in cases where urinary complications are suspected or established as the change of position assists drainage of the kidneys. Some patients find it exhilarating to be turned, in others it induces headache and vomiting

The method of making a plaster turning-case is described in Chap IV

Indications for turning a patient. (1) In an adult rise of temperature or complaint of pain in the back, which may indicate the beginning of a pressure sore or in a child, disturbed sleep or fretfulness. Though it is not desirable to turn a patient in the evening because of the systemic upset which *may* be caused no complaint of pain or pressure must be ignored. If left overnight a deep sore may result. (2) A broken nipple or pelvic bar this must be mended at once while the patient lies in his turning case or a suitable temporary frame must be found. (3) Renal complications. (4) Wet and dirty frames or saddles in very young or incontinent patients. (5) For treatment of the skin of the back and for leg exercises to regain *flexion of* the knees preparatory to a spinal graft In very rare cases, for exercises for the spinal muscles. These are ordered *only if*

the lesion is completely quiescent and are given by a physiotherapist.

Procedure. Screen the bed. Collect on a tray the necessary articles, washing bowl, toilet materials, clean wool and bandages, material for re binding the frame a Lucas wrench, a wooden block, and three turning straps (one long and two short) *Place the turning case in readiness.* Strip the bed, and the patient leaving him covered with a blanket. Lift him



Fig 96.
Plaster of paris turning-case with struts to support the head in tuberculosis of the cervical or upper dorsal spine. (Used for the patient depicted in Fig 107)

to the end of the bed, so that the feet will hang over and not be pressed into the bed. Place the straps ready in position *before undoing bars or bandages,* so that the patient is disturbed as little as possible. Place a block under the cross-bar and remove the knee bandages. Untie the shoulder ties, and bend the nipple-bars out over the block. Bend the pelvic bars back in the same way. The bars will break unless a block is used. Next, cover the trunk and legs with splint wool. If the lesion is in the cervical or high dorsal region a brow band will be incorporated in the turning case so that the head is supported. (Fig 96) Place the turning case in position on the patient's body and while an assistant presses it down, fasten the straps firmly and buckle at the side. The short ones are fastened just below the

knees. (Fig 97) Four nurses, at least are needed to turn an adult patient and more may be necessary Two nurses stand



Fig 97
First stage in turning The patient is lifted to the end of the bed, and the turning case is strapped on as shown.

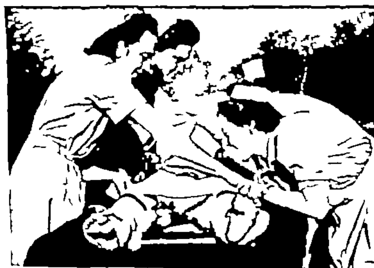


Fig 98.
Second stage in turning showing the method of lifting the patient.

on each side of the bed. Nurse 1 standing on the patient s left slips the right arm under the frame and grasps the opposite nipple bar as low down as possible grasping the other nipple-bar

with her left hand. Her opposite number Nurse 2 faces her and grasps the nipple-bars as close to Nurse 1 as possible. Nurse 3, standing on the patient's left, slips her right arm under the frame and grasps the opposite knock-knee bar while Nurse 4 faces Nurse 3 and grasps the left knock-knee bar with her right hand and the right one with her left (Fig. 98.) At the command given by Nurse 1 "one, two, three, up, over and down" the patient is raised, turned in the air and brought smoothly down on to the bed. (Fig 99.) *It will be seen that the position* of the nurses' arms is then reversed. Quickly undo the straps



Fig. 99
Third stage of turning. The patient is being quickly and smoothly raised and turned in the air

and remove the frame. A pillow under the head and neck adds to the patient's comfort and he should be reassured from time to time. Turnings must not be carried out in a jaunty manner. The patient must not be tossed high into the air and all movements must be smooth and orderly so as to disturb fixation as little as possible. Mechanical turning devices are not recommended as some lateral movement of the spine is certain to occur.

Inspect the back, and note the following points:—(1) The presence of a *pressure sore or local redness* indicating that one is impending. (2) The general condition of the skin. (3)

The shape of the spine and any change in the kyphos, if present (4) Examine the back for swelling which may indicate an abscess. Next wash the whole area of the back with hot water and soap It is also a good opportunity to wash the buttocks, the back of the legs and the hair Then, with a good lather of soap treat all areas subjected to pressure i.e the kyphos, the angles of the scapulae the posterior superior iliac spines, and the sacrum. Rub in the lather until it disappears



Fig 100
The patient lies in her turning case whilst the back is treated and the saddle and frame cleaned. Note that when possible treatment is carried out in the open air

and the skin is flushed and rosy (Fig 100) If sores are present they are treated with sterile dressings and the surrounding areas rubbed to improve the circulation. At all costs further pressure must be avoided, and this is done by either (a) padding-off the area with felt (b) grooving the saddle to the shape of the bony prominence or (c) substituting a plaster bed for the frame It is quite useless to cover areas subjected to pressure with bits of wool or felt. This will only increase the pressure

To protect a kyphos. (1) Cut strips of felt of suitable length, and bevel the edges. Place them on either side above

and below the bony prominence so that the kyphos protrudes through the square thus formed. If the kyphos can still be felt when the hand is pressed over it, the felt is not of sufficient thickness, and more must be added. *The edges of the felt strips must be bevelled*, or further pressure will result. Felt is never placed directly on to the skin. Lint or old soft linen is used for protection. (2) Cut out pieces of felt in the shape of laurel leaves, bevelling the edges. Lay these over the kyphos and cut a cross in the centre of the leaves in such a manner as to allow the kyphos to rest in a hollow. The same test is used to determine the thickness. (3) *To groove a saddle.* Place a little oily white ointment (e.g. zinc ointment) on the highest point of the kyphos. Lay the saddle on the back in the correct position and press down gently. When it is removed, an impression is left on it by the ointment indicating where the groove should be. Mark out the groove and send it to the splintmaker with instructions as to width and depth. The part thus marked is hollowed out and lined with chamois leather. The kyphos fits snugly into the groove and pressure is relieved. (Fig. 101.)



Fig. 101.
Grooved saddle to protect a kyphos.

When the patient's back has been treated, cover him with a blanket and inspect the frame. Remove the saddle, clean thoroughly with saddle-soap, scraping off all dead skin and debris. Put it in the fresh air for a time. It is always advisable to keep two saddles for a child or an incontinent patient. Renew the binding of the frame, inspect and renew the guards if necessary. Thread a clean bandage through the shoulder-guards. Collect helpers, remove the blankets, and place first the saddle, then the frame, in correct

position on the patient's back. Fasten the straps and turn the patient back in the same way. Remove the turning-case. Tie the saddle by lifting the patient to the side of the bed—be sure he is in correct position. Replace the packing under the knees, then the bars and shoulder ties. Replace the clothing, bandage the legs and leave the patient comfortable.

Occasional sequlae associated with turning. (1) *Haematuria.* The patient who has been lying on his back for any length of time may have some gravel or even larger calculi in the renal pelvis. On turning this is disturbed and may start to pass down the ureter with resultant haematuria, and sometimes, renal colic. This usually clears up and is rarely sufficient in amount to require treatment. (2) *Vomiting or haematemesis.* Vomiting is due to the change to an unaccustomed position, and if violent may be accompanied by haematemesis. This also rapidly settles down. (3) *Acute dilatation of the stomach.* This is due to the change of position and constitutes a medical emergency.

Maintenance of correct position. It is of the greatest importance that the patient is in correct position on the frame from the first moment. Many patients will tend to slip downwards (i.e. the tip of the coccyx will be below the fork of the saddle) during the first few days. This is due to the settling of the lumbar spine on the saddle and to stretching and relaxation of the abdominal muscles and hip-flexors. It may be necessary to adjust the pelvic bars daily for a short time. If a patient is left day after day in an incorrect position, the saddle will gradually accommodate itself to the body and become so dented and misshapen that no matter how often the patient is adjusted, he will slip back into the grooves and will never be either comfortable or in correct position. The only remedy for this is a new saddle and renewed vigilance on the part of the nurse. If a patient perpetually slips down his frame it is probably due to some activity on his part (e.g. raising himself on his hands to view the passers-by) and the application of groin straps will usually correct it. It may also be due to faulty and uneven mattresses, fracture-board beds, or flooring or to careless lifting or insufficient immobilisation. If the tip of the coccyx is found to be above the fork of the saddle it may be due to any of the faults afore-

mentioned or to a too-large block under the cross-bar. When the patient is found to be in a wrong position, he must be adjusted forthwith.

Procedure. Four helpers are necessary for an adult. Strip the bed, remove the clothing, remove bandages and bend the bars out as for a turning. The nurses take up their positions as for placing a patient on a frame (Fig. 90) and at a command, lift him up or down the frame as the case may be. When the correct position is obtained the bandages, bars, etc. are replaced and the patient left comfortable.

Prevention and correction of deformity

The nurse must be acquainted with the common deformities associated with prolonged frame fixation, and her aim must be to prevent their occurrence by strict observation, *daily* attention to splintage, and close co-operation with the physiotherapist.

Deformity of the spine. A *kyphos* is due to collapse of the vertebral bodies and is the result of Nature's effort to fuse the diseased vertebrae together and promote healing. In many cases, it is unwise to attempt to undo this, as though deformity may be corrected, the diseased vertebrae may be so opened out as to prevent healing. In most cases, it is considered desirable to attempt to develop compensatory curves above and below the lesion so that when weight bearing is resumed the spine will appear straight (Fig. 102.) Correction can be attempted by the following methods:—(1) By pads under the kyphos. (2) By hyperextension of the frame. (3) By a Calvé shell. (4) By nursing the patient on his face.

(1) *Pads under the kyphos.* The patient is turned, and leaf-shaped pads of felt covered by linen or lint are placed between the kyphos and the saddle, gradually increasing them in thickness so that continuous pressure is exerted on the kyphos. The edges of the pads must be bevelled and a careful watch must be kept for signs of pressure on the kyphos.

(2) *Hyperextension of the frame.* The patient is turned, and the frame is *marked opposite to the highest point of the kyphos.* It is then sent to the splint maker and hyperextended to the degree ordered. The patient is turned back in the usual

way and the frame is supported on blocks. As a rule not more than 5 or 10 hyperextension is ordered.

(3) *A Calvé shell* is made as the patient lies on his face in his turning-case. Take a piece of felt of sufficient size to cover the whole back between the kyphos and the seventh cervical vertebra. Cut several further pieces, each slightly smaller



Fig. 102.
Large kyphos due to tuberculosis of the lower dorsal spine showing compensatory curves above and below the lesion. Note that when the patient is dressed the kyphos is scarcely discernible.

than the other. Lay the layers of felt between the kyphos and the seventh cervical vertebra until the highest point of the kyphos and the layers of felt are in the same plane. Place the layers of felt on a flat surface and slope the edges next to the kyphos with a sharp knife. Lay them in position and proceed as for making a plaster bed. (Chap. IV.) When the bed has been dried and lined, the patient is placed in it. He is then turned at weekly intervals, and one layer of felt removed each time. As

Treatment Abduction frame, skin extensions on the side on which the pelvis is raised with groin-strap on the opposite side. If a plaster bed is used extension bows are incorporated in it.

Flexion contracture of the hip. This may be secondary to a lordosis, or to spasm of the psoas muscle or to a gradual yielding of the frame and saddle to the patient's weight The hip flexor muscles quickly adjust themselves to their shortened position and the deformity becomes fixed.

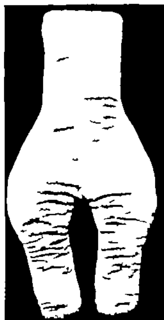


Fig 104.
Breeches saddle.

Treatment Skin extensions and a groin strap may be ordered. Strict attention to the position of a patient on a frame will, as a rule prevent it occurring A very heavy patient with large buttocks quickly makes a deep impression on the saddle Sometimes it becomes so thin and flattened that the hips are practically unsupported and become fixed in flexion. Such patients (they are usually of the fair sex) should have a special saddle made in the shape of a pair of riding breeches with widened portions to accommodate the hips. (Fig. 104) The only alternative is to exchange the frame for a plaster bed

Deformity of the lower limbs. *Internal or external rotation of the hips* is due to insecure and inadequate bandaging and is rarely a fixed deformity

Genu recurvatum (Fig 105) The importance of continual and adequate support for the head of the tibia has already been stressed

Genu valgum This is especially likely to occur in women and children, but can be largely prevented by firm correct bandaging

Treatment Cover three pads of felt of suitable size with nt wool. Place one on the inner side of the knee and dage to the knock-knee bar from without inwards over plenty wool. *Place the other two pads* above and below the outer of the knee to provide counter sure and bandage from within wards.

Genu varum is usually due to lty bandaging

Treatment Place pads of felt the limb in the opposite manner that described for knock knee one pad on the outer side of knee and two on the inner side) d bandage in the opposite way sure that corrective bandaging not so tight as to cause pressure d interfere with the blood or rve-supply to th limb It ould be removed at once should e patient complain of pain, mbness, tingling or inability to rsiflex the foot.



Fig 103.
Genu recurvatum due to insufficient packing under the head of the tibia during prolonged frame fixation.

Foot deformities. *Talipes equinus* (drop foot) may be postur due to pressure of bedclothes nd neglect of exercises, espec lly in very ill or debilitated pat nts, or to pressure on the ex rnal popliteal nerve by tight andages. *Treatment* Remove the cause Support the foot at a ight-angle in a club-foot shoe or plaster shell Exercises and lectrotherapy may be ordered. All areas subjected to pressure rom the club-foot shoe or plaster shell (e.g the heel) must be reat d regularly with soap and water to prevent pressure-sores, he foot being supported at the right angle throughout

Pes cavus (claw foot) is due to neglect of foot exercises, or pressure of bedclothes. *Treatment* Remove any pressure. Special exercises are given by a physiotherapist

Talipes calcaneus (long heel). This is due to insufficient packing under the knee and stretching and wasting of the gastrocnemius. It may also be due to incorrect foot-exercises which force the foot into extreme dorsiflexion. *Treatment* See that the packing under the knee is always adequate Foot exercises are given by a physiotherapist.

Talipes calcaneo-cavus (long heel and claw foot). This is probably the most common foot deformity to occur during frame-fixation. (Fig. 106) It is a combination of the two above-mentioned deformities and is caused by inadequate support for



Fig 106.
Frame-feet. Calcaneo-cavus deformity of both feet occurring during frame fixation.

the knee pressure of bedclothes on the toes and forefoot and incorrect exercises. *Treatment* Remove the cause Exercises will be given by a physiotherapist.

Operative correction. Should any foot deformity become fixed the surgeon may decide to correct it by operation when the convalescent stage of the disease has been reached.

Summary of sequelae associated with prolonged immobilisation in tuberculosis

(1) **Physical sequelae.** *Deformities* which commonly occur during fixation have already been described. Many of these tend to right themselves with weight-bearing and improvement of the musculature In a great many cases, for example those immobi-

lised for two or three years, the problem is not one of a particular deformity but of gross enfeeblement of the entire general musculature. This is often accompanied by a corresponding slowing down of normal physiological processes. The abdominal wall loses its tone and *constipation* becomes a bug bear. Many patients reach a stage when the bowels are never completely emptied except by artificial means.

Renal complications due to prolonged decubitus have already been described. *Amenorrhoea* is not uncommon.

(2) **Mental sequelae.** In many cases, the physical inertia induced by prolonged fixation is accompanied by corresponding mental lassitude. The patient becomes lethargic, morose, disagreeable and difficult to please. A special note is necessary with regard to children, in whom this mental deterioration is particularly distressing to see. The normal cheerfulness is replaced by whining, fretfulness and tantrums, and the child becomes refractory and dirty in habits. Spoiling of individual children is to be deplored, and each child should receive his full share of sweets, toys, etc., and (most important of all) of his nurse's attention.

Conclusion. The nurse has a great responsibility in dealing with these cases. Sometimes the decline in the patient's physical and mental condition is so gradual as to pass unnoticed, and he may appear quite well. The nurse must do all in her power to prevent this sad deterioration by thorough and conscientious treatment of the patient's body, and by encouraging him to retain a lively attitude of mind.

Management during X ray examination

The patient is lifted on his frame on to a sheet spread on the X ray table. The bars are unfastened and bent back over a block, and the knee-bandages removed. Three nurses are required to lift the patient, grasping the shoulders, pelvis and legs. At a command, he is lifted "en masse," whilst a fourth nurse removes the frame and laid on the table. *The spine must be kept in exactly the same position as it was on the frame.* In a cervical lesion, a nurse steadies the head throughout. Small pieces of wool are placed beneath the knees to prevent hyperextension. The antero-postero film is now taken.

For the lateral view place a pillow between the legs, grasp the sheet and draw the patient towards you. Then carry the sheet over the patient's body and roll him gently and smoothly on to his side. **This is positively the only occasion when the patient is turned on his side.** A small pillow may be used to fill in the curve of the waist, and the head must be comfortably supported. When the lateral X ray film has been taken, roll the patient back in the sheet in the same way. Three nurses lift the patient while a fourth places the frame beneath him in the correct position. Replace the bandages and clothing, return the patient to bed and leave him comfortable.

Nursing care of a patient in a plaster bed

The patient is lifted into the plaster bed in the same manner as for a straight frame. The daily routine is similar with special attention to the following points —

(1) The bed is inspected daily for softening or cracks.

(2) Urine and faeces must not be allowed to soak into the bed; a urinal should be used for patients of both sexes. (Fig 94.)

(3) The space which is cut out of the bed for nursing purposes must be of exactly the right size. If it is too small, it will be impossible to keep either the patient or the bed clean. If it is too large, the buttocks will bulge through and become swollen and indurated. A V-shaped space is preferable to a half-circle for very heavy patients.

(4) As the bed is raised on wooden blocks, the feet must be supported on pillows, to prevent contracture of the tendo-achilles. (Fig. 89.)

(5) Turning is carried out as for a straight frame, and the bed is relined with clean stockinette.

Special nursing points for tuberculosis of particular regions of the spine

(1) **Cervical spine.** The head must always be comfortably contained in a sunken headpiece and controlled by a collar and brow-band. (Fig. 107.) *The collar* fits comfortably round the neck and buckles at the side. It is covered with lint or other soft material which can be easily renewed when soiled. *The*

brow-band is made of perforated leather lined with chamois, and is fitted with a strap and buckle It is essential that it is made on a cast of the forehead, when it will conform exactly to its contours, and ensure both immobilisation and comfort It is also essential that the strap is threaded through slits made in the headpiece so that it embraces the head just below the occiput buckling on the other side

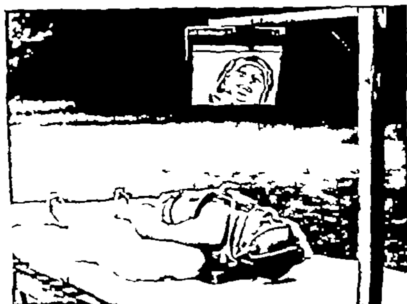


Fig 10
Immobilisation a tuberculosis of the cervical spine Note the tilting mirror—an essential adjunct to the plastage

A *tilting mirror* should be fixed to the patient s bed, so that he can observe his surroundings without being tempted to move his head. He must be fed and washed the collar and brow band is removed for toilet purposes, and the eyes, nose and mouth require special attention Watch for pressure sores on the back of the head, the mastoid processes, the mandible and on the forehead. See that the ears are not pressed upon, crumpled up or protruding over the sides of the headpiece. Watch for swelling in the neck, and never ignore any complaint of pain in the neck or throat hoarseness, or difficulty in swallow

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ing as this may indicate a retro-pharangeal abscess. Look for signs of muscle weakness or spasticity of the extremities.

(2) **Dorsal spine.** If a headpiece is used, treat as for cervical region watch for abscess formation along the ribs or in the loins, and especially keep a close watch for signs of pressure on the spinal cord (e.g. spasm of the feet) as it is in this region that paraplegia is most likely to occur Do not allow the patient to play wind instruments (for example, trumpets) Immobilisation of the dorsal spine is difficult in any case owing to the respiratory movements of the ribs at their attachments to the dorsal spine any forced respiration is therefore contraindicated.

(3) **Lumbar spine.** See that the lumbar spine and pelvis is always perfectly immobilised either by groin straps or pelvic-band Remember that abscess formation is common in this region and examine the patient daily for swelling in the loins, abdomen or thighs.

POTT'S PARAPLEGIA

Paraplegia is one of the most serious complications of tuberculous disease of the spine. It is also one of the most distressing to the patient— in an infant most melancholy to see, in an adult most miserable to endure. (Percival Pott.) It is caused by pressure on the spinal cord, which may be due to one of the following factors —(a) Abscess formation (b) sequestra (c) sudden collapse of a vertebra (d) vascular catastrophe. As the spinal cord extends only to the level of the second lumbar vertebra paraplegia occurs most commonly in caries of the cervical and dorsal regions.

Paraplegia may be roughly divided into two types:—(1) that of early onset i.e. manifest within eighteen months from the commencement of disease (2) that of late onset i.e. manifest later than two years from the commencement of disease. This division is made chiefly from the point of view of prognosis, the likelihood of recovery being greater in cases of early onset.

Paraplegia may be either partial or complete and consists of an interruption of normal transmission of impulses along the spinal cord. The earliest sign is usually spasticity of the lower limbs, and inco-ordination of voluntary movement. This is due

to diminution of the inhibitory effect of the higher centres on the lower reflex area. The ankle and knee jerks are increased, the abdominal reflexes are lost and Babinski's sign may be positive. Passive movements of the limbs are accompanied by some resistance and there may be clonus of the ankle and patella. Voluntary power may be at first weak, and later absent. One leg may be involved before or to a greater extent than the other. If the condition progresses, voluntary power may be completely lost together with loss of control of the bladder and rectum, and finally anaesthesia may develop. When this stage is reached, the patient is virtually "cut in half," so that the lower part of the body, i.e. that part supplied by nerves arising from the spinal cord below the lesion, is governed only by its reflexes and is no longer under the control of the higher centres in the brain. Any stimulus of the skin initiates violent spasm, often in the nature of a mass reflex in which the limbs are flexed and the bladder and rectum emptied.

N.B. As the onset of paraplegia is usually insidious, all cases of tuberculosis of the spine, particularly those with lesions in the cervical and dorsal regions, must be carefully watched and systematically examined for the above signs, and treatment instituted at once.

Treatment. (a) *Conservative treatment* consists of general measures as already laid down, combined with strict immobilisation of the patient as a whole and the elimination of all sensory stimuli to the lower limbs. (b) *Operative treatment* may be adopted to relieve pressure on the spinal cord.

Conservative treatment. In addition to the general measures already described, the following important points should be noted. (1) The patient's bed must be in a corner of the ward; jolting or jarring of the bed must be avoided. (2) Everything must be done for the patient; movement of the arms is not encouraged. All routine procedures, such as washing and bed making, are carried out in a smooth, orderly manner avoiding the slightest ungentle handling; in fact, handling of any kind must be reduced to the minimum compatible with proper nursing care.

Splintage consists of a frame or a plaster bed with a

ing, as this may indicate a retro-pharangeal abscess. Look for signs of muscle weakness or spasticity of the extremities.

(2) **Dorsal spine.** If a headpiece is used, treat as for cervical region; watch for abscess formation along the ribs or in the loins, and especially keep a close watch for signs of pressure on the spinal cord (e.g. spasm of the feet), as it is in this region that paraplegia is most likely to occur. Do not allow the patient to play wind instruments (for example, trumpets). Immobilisation of the dorsal spine is difficult in any case owing to the respiratory movements of the ribs at their attachments to the dorsal spine; any forced respiration is therefore contra-indicated.

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sunken headpiece collar and brow-band if the lesion is high. Hyperextension of the frame or plaster bed may be ordered, in an endeavour to "open out" the diseased vertebrae and relieve pressure on the spinal cord. (Fig 108) The patient is fixed on the frame in the usual way The feet are then immobilised in club-foot shoes, so as to hold the lower limbs at rest and eliminate all sensory stimuli. Plaster shells should

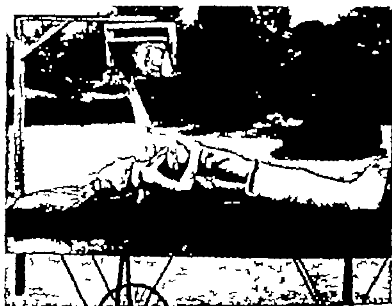


Fig 108.

A case of Pott's paraplegia immobilised on a hyperextended frame. The lower limbs are immobilised in club-foot shoes. Note the tilting mirror. In spite of her stringent fixation, this little girl enjoyed lessons and games with other children.

not be used, as when spasm occurs the heels, malleoli, and metatarsal heads are rubbed against a hard surface and pressure sores are certain to occur. Correctly applied club-foot shoes supply comfortable support without pressure on bony points.

Application of the club-foot shoes. *These must be of the correct size and preferably of the "winged" variety* (Fig 42.) Place a layer of splint wool on the sole-piece; further layers are placed on the calf piece and must be of sufficient thickness to allow the heel to rest in the curved portion of the



Fig 109.
Shows the method of padding the club-foot shoe before application

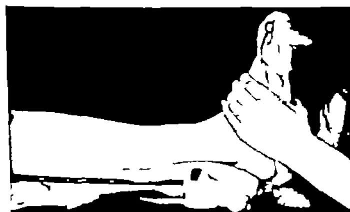


Fig 110.
Application f the lub-foot shoe. There must be sufficient wool packing on the calf piece to allow of the introduction of two fingers between the heel and the metal bar of the shoe

shoe without actually touching it. (Fig. 109) If there is severe spasm, an assistant steadies the limb using a firm, steady yet gentle grasp The club-foot shoe is then gently slipped into position beneath the foot and leg. The padding on the calf piece must be of sufficient thickness to allow of the introduction

of two fingers between the heel and the metal bar of the shoe (Fig 110) See that the top of the shoe does not dig into the calf, and that the head of the tibia is supported. Place a *thick*



Fig 111.
A thick pad of wool is placed ove the front of the ankle and the heel is bandaged firmly into the shoe



Fig 11..
The completed bandage

pad of wool over the ankle joint and start to bandage at this point the first turn of bandage must pass directly over the heel and hold it firmly in the shoe. (Fig 111) Bandage firmly and evenly in figures of eight carrying two or three turns

through the wings of the shoe Continue until the foot and ankle is covered, leaving the toes visible for inspection. (Fig 112.) It is advisable for beginners to practise this procedure on a colleague before attempting it on a paraplegic patient Bandage the legs over plenty of wool, using a separate bandage. See that the bedclothes do not *touch* the toes, and that the club-foot shoes are clear of the bed.

Daily nursing care. The golden rule in nursing cases of Pott's paraplegia is, *immobilise the patient make him comfortable then leave him alone* So long as the lower limbs are *comfortably* fixed, *do not interfere with them* Do not touch the feet and legs, much less wash them, and do not cut the toe-nails. They should be left severely alone for weeks or even months if necessary as handling the limbs constitutes a sensory stimulus which will be answered by a motor response and increased spasm.

Pressure-sores need not occur—and their appearance should be regarded as a major calamity Not only will the painful and distressing spasm be increased thereby but the necessary treatment will entail the very thing one tries to avoid—handling and movement of the limbs, resulting in increased spasm. Sores are especially likely to occur on the heels, either from pressure or from friction if the heel rubs against the club-foot shoe when spasms occur It is therefore of vital importance that the club-foot shoes are correctly applied. Though the slightest disturbance of the patient is undesirable no complaint of pain, pressure or *increased spasm* must be ignored. Sores are treated with sterile dressings, and *further pressure must be prevented*

Turning and readjustment of splintage will be carried out at the discretion of the ward sister but if fixation is stringent, perfect and comfortable, the patient can be left undisturbed for many weeks. Turning is best carried out with the club-foot shoes still in position. While the patient lies in his turning-case an assistant grasps the feet and steadies them and the club-foot shoes are removed. The heels should *not* be rubbed unless there are signs of pressure which does not occur if the shoes are correctly applied.

Loss of control of the sphincters. This must be carefully

watched for and if it occurs, evacuation of the bowels by enemata, and drainage of the bladder by a supra-pubic cystostomy may become necessary Every effort must be made to prevent urinary infection If in spite of prolonged conservative treatment or operative interference it is thought that paralysis may be permanent the patient may be fitted with ambulatory splintage and allowed up This usually consists of a spinal support strapped to two callipers, which combined with crutches enables the patient to get about with a 'tripod' gait (Fig 169)

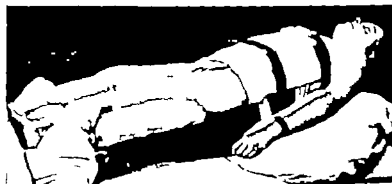


Fig 111.
A plaster pelvic-band is applied and the legs are mobilised over pillows in preparation for weight bearing

Operative treatment is directed towards relieving pressure on the spinal cord, and may be (1) Costo-transversectomy (2) Laminectomy (3) Antero-lateral decompression.

LATER TREATMENT OF TUBERCULOSIS OF THE SPINE

Later treatment for tuberculosis of the spine may be *conservative* or *operative*

Conservative treatment is continued if the patient is too young too old, or too ill for operation, or if it is thought that spontaneous fusion of the affected vertebral bodies will take place without operative interference In uncomplicated cases, later treatment consists of weight bearing in some form of retentive splintage applied according to the part affected.

Indications that weight bearing may be resumed. (a)



Fig. 114.
Doll collar (F rquharson.)



Fig 115.
Minerva jacket applied f r tuber culosis of the cervical spine



Fig 116.

Spinal support and colla pplied for tuberculosis of the upper dorsal pine



F g 11

Casted block leather ja ket used the lat treatment f ex tensi tuberculous lesion f the lower dorsal spine

The patient's general health is at a high level, indicating that he has overcome the primary lymphatic infection. He is apyrexial, looks well, eats well, sleeps well, and is free from pain. (b) Serial X rays show no further destructive changes over a sufficiently long period (e.g. six months) and recalcification is occurring. (c) Absence of complications, e.g. abscess formation.

On the other hand, the presence of certain complications is sometimes an indication for terminating prolonged fixation. Urinary or chest complications may render prolonged decubitus undesirable, or the presence of chronic discharging sinuses, and suspected amyloid disease. Sometimes the improvement in the morale of the patient justifies the termination of fixation in spite of such complications as these. As a preliminary measure a plaster pelvic band may be ordered and the patient allowed to mobilise his legs over pillows in preparation for weight-bearing. (Fig. 113.)

Retentive splintage for different regions.

(1) *Cervical region.* (a) Doll's collar either plaster leather or celluloid. (Fig. 114.) (b) Minerva jacket. (Fig. 115.)

(2) *High dorsal region.* (a) Plaster jacket including the neck, in some cases the head too. (b) Spinal support with collar attached. (Fig. 116.) (c) Block leather or celluloid jacket with collar attached.

(3) *Lower dorsal region.* (a) Plaster jacket from clavicles to hip-joints. (b) Spinal support. (c) Block leather or celluloid jacket. (Fig. 117.)

(4) *Lumbar and sacral region.* (a) Plaster spica including one leg (above knee.) (b) Block leather or celluloid spica including one leg. (Fig. 118.) (c) Supporting belt. (Fig. 119.)

To apply a spinal support. Screen the bed. Prepare the necessary articles, the turning-case straps, splint wool, back support bender and toilet articles. Strip the bed, remove the clothing and bandages, and bend out the bars as for a turning. Undo the shoulder straps of the support at the lower buckle and the webbing waist band. Detach the pelvic-band and lay it, with the groin straps attached round the pelvis half way between the iliac crests and great trochanters. Cover the trunk and limbs with splint wool and turn in the usual way. Lay

the support on the patient's back; it should terminate exactly opposite the tip of the coccyx. When pressed down against the sacrum, it should stand away from the shoulders for three finger breadths. (Fig 120) If not place the lower end of the support

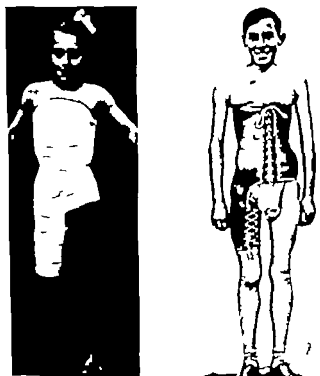


Fig 118.

Splintage for tuberculous disease of the lumbar spine. The first picture shows a plaster spica jacket, the second a casted block leather spica. Note that the patient has outgrown the leg piece of th splint t should extend t just bove the knee

with its posterior surface towards you, between the bars of the back-support bender and gently bend it backwards to the required angle (Fig. 121) Only experience can teach the nurse the amount of bending required, as it will depend entirely on the individual case Lay the support again on the patient's back. It should then conform closely to the curves of the spine whilst standing away at the shoulders. With the aid of an assistant, fasten the pelvic band, taking care not to pinch the

skin. See that an even amount of strap is present on either side It is vital that the pelvic band is *always* kept tight, as it provides the fixed point from which extension of the spine takes place, and the integrity of the support depends upon it. Fasten the shoulder straps, by placing the hands under the front of the shoulders and drawing them back to the support, always using the lower buckle. Do not pinch the skin, and see that it is not wrinkled beneath the straps. Fasten the groin straps these need not be tight whilst the patient is recumbent, but once he becomes ambulant they must always be kept tight or the support will ride up If a collar is ordered, apply by slipping it under the chin, and fastening it at the back on to the buckles provided on the support, as shown in Fig 116 An abdominal belt is sometimes ordered. (Fig. 122.)


Fig 119
Supporting belt used in the late treatment of tuberculous of the lumbar o sacral region.

The turning straps are then applied, and the patient turned on to pillows, placed in readiness at strategic points so as to avoid pressure from the straps as far as possible. Most patients are comfortable if the pillows are arranged in the following manner:—(a) One or two pillows placed so as to form an elevation under the lumbar spine. The shoulders and hips then tend to fall away from the pressure of the straps in front. (b) One pillow under the shoulders. (c) One pillow under the head. (d) One or two pillows under the knees so that they are comfortably flexed. (Fig. 123) The patient should be encouraged to move about in bed once he has become used to the support Some patients prefer to wear a vest under the support If worn, it must have sleeves and be

of smoothly woven material. It is cut down the front and fitted with tapes, so that it is put on like a coat as the patient lies on

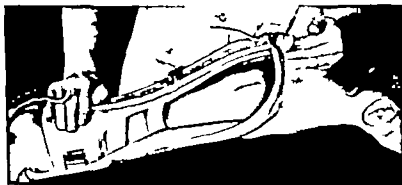


Fig. 120
Application of a spinal support. When the lower end is pressed down against the sacrum, the upper end should stand away from the shoulder for three finger breadths.

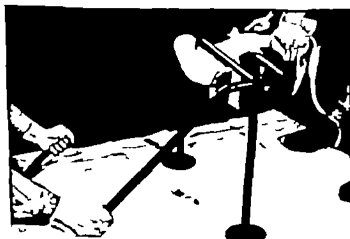


Fig. 121
Bending a spinal support.

his face. A woolly vest is not suitable for wearing under a back-support.

Daily nursing care. At first it will be necessary to treat the areas under the pelvic band and the shoulder straps every four hours. Once the skin has become accustomed to the pres-

sure, twice daily should be sufficient, and later once daily. The whole back is treated once a day.

Procedure. Prepare a tray with toilet articles. After the routine toilette, strip the bed and remove the clothing, leaving the patient covered with a blanket. Undo the webbing waist-band, turn the patient on to his face, bring him to one side of the bed, and arrange the pillows so that one supports the chest, and another the flexed knees. The patient must be lying in a comfortable position when the straps are undone and *all movement must be forbidden* until they are refastened. Undo the shoulder straps carefully so as not to damage the skin. Undo the pelvic-band, and lay the support back across the patient's legs. (Fig. 194.) The pelvic-band is always unfastened last and refastened first.



Fig. 122.
Spinal support with abdominal belt.

Look for signs of pressure over the kyphos, if present, the angles of the scapulae, the posterior superior iliac spines and the sacrum. Note any swelling or change in the shape of the back. *Wash the whole area of the back* and treat it with a good lather of soap, especially those areas subjected to pressure. Wash the axillae, then, with a good lather of soap, treat the areas beneath *the shoulder straps*. It is usually most convenient to treat both shoulders at the same time. Dry very carefully and powder lightly. Inspect the support and the straps. Clean with saddle soap and scrape off any dead skin. Treat the shoulder-straps and groin straps as you would the skin, keeping them always in their curves to avoid cracks. Cracked straps are a contributory cause of pressure-sores. Fasten the pelvic-band, then the shoulder-straps. When these are secure, turn the patient on to his back, undo the pelvic-band and groin-straps and treat the areas beneath them in the same way. It is not advisable to treat the areas beneath the pelvic-band while the patient lies on his face, as the areas most subjected to pres-

sure cannot then be reached without undesirable movement. Also, the pelvic-band can be tightened up more easily without pinching the skin while the patient lies on his back. The shoulder-straps and pelvic band must be buckled into the same



Fig. 123.
Showing method of arranging pillows so that pressure on the shoulders and hips is relieved.



Fig. 124.
The support is unfastened and laid across the patient's legs for treatment of the skin of the back.

holes each time. Always note which hole is being used before undoing the strap. After a time the straps tend to stretch and will require to be tightened. Fasten the webbing waist-band, re-arrange the pillows if necessary, make the bed and leave the patient comfortable.

If, in spite of conscientious treatment, pressure-sores occur the following measures may be adopted —

Pressure sores over a kyphos The kyphos may be padded off with leaf shaped pieces of felt as described on page 152. In very thin patients, it may become necessary to cover the entire surface of the back support with felt.

Procedure Remove all straps and lay the back-support on a piece of sterilised felt. Cut out round it with a sharp knife leaving a little for turning. Roll the felt on to the support from below upwards, cover with lint or old linen, and stitch firmly

Pressure sores under the shoulder straps The aim must always be to distribute pressure over a larger area. The tendon of the pectoralis major is the most usual site for a pressure-sore It is useless to tuck in bits of wool, as this only increases the pressure (a) Lay the patient on his back, and undo the shoulder straps. Take a soaked plaster bandage and lay it in *smooth* layers over the shoulder moulding it *closely* remove it when set When dry it can be worn under the shoulder strap and will distribute its pressure (b) Take a piece of soft leather (e.g a frame shoulder-guard) and soak thoroughly in warm water Whilst it is still wet apply it to the shoulder and mould it closely When dry this will distribute pressure in the same way (c) Cover the entire surface of the shoulder straps with felt covered with lint

Pressure sores under the pelvic-band. (a) Cover the entire surface of the pelvic band with felt and lint Make sure that it is firmly secured or it will slip about and cause further pressure (b) If there is a localised sore apply two small pieces of adhesive felt to the pelvic band, on either side of the sore

If these measures fail, it may be necessary to make the patient comfortable on his pillows and leave the straps undone for short periods, or alternatively the patient must lie in his turning-case

A restrainer must be applied in the case of a child, and all *movement must be forbidden*

After a preliminary period of mobilising in bed, when leg-exercises are practised intensively the patient is allowed up.

Gradual weight-bearing will be introduced by a physiotherapist The support will require moulding tightening and adjustment from time to time when the patient stands. **No daylight must be visible between the spine and its support, and the straps must always be *tightly fastened*** A loose ill-fitting spinal support is neither use nor ornament

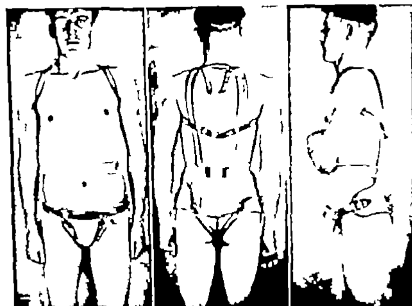


Fig. 113.
Jones spinal support for use in tuberculosis of lower dorsal or upper lumbar spine Note that when the patient is examined from the side no daylight is visible between the spine and its support

Block-leather or celluloid jacket. This is indicated if there is an extensive lesion with gross deformity It is made on a cast and a collar may be attached as in the spinal support An axillary crutch may be ordered on one side to support a low shoulder Groin straps may also be ordered. The jacket may be made in two halves, laced up each side or it may lace in front as shown in Fig 117

To apply the jacket The patient is lifted en masse from the frame into the support and it is tightly laced. The patient is made comfortable on pillows.

Daily nursing care. All areas subjected to pressure must be treated four hourly at first, and thereafter once or twice daily as already described for a spinal support. If the jacket is made in two halves, the lacing is unfastened and the front of the body treated first the jacket is then laced, the patient is turned on to his face and the back treated in the same way Pressure points may be padded off with felt as described for a kyphos. Small bumps in the block leather can be hammered out. It is always advisable to keep the turning-case handy until it is certain that the jacket fits comfortably and no further adjustments are necessary

A plaster spica including one leg is applied and nursed as described in Chap IV When changing the spica, it is usual to immobilise alternate legs.

Block-leather or celluloid spica. This is more comfortable if made in two halves. The nursing care is as already described for a jacket. If the support terminates above the knee, the patient must be watched for genu valgum on the side which is immobilised, and it may be necessary to raise the inner side of the foot wear

A supporting belt (Fig 119) is made on a cast, and is applied in the same manner as a block leather the nursing care is the same.

Operative treatment consists of a spinal fusion of the Hibbs or Albeé type, and is generally performed only when the disease is quiescent, the object being to promote healing and prevent recurrence.

Preparation for a spinal operation. (a) The nature of the operation is explained to the patient or his guardian, and written consent is obtained (b) The general health must be maintained at a high level. Chest and urinary complications are excluded by examination, and the blood-group ascertained in case transfusion is necessary (c) The patient is turned daily for attention to the general cleanliness and for treatment of the skin of the back *this must be in perfect condition.* Also for exercises to be given so that flexion of the knee is regained to at least 90 if a graft is to be taken from the tibia. (d) A new turning-case is made which must be cut down into a V-shape in front so as not to interfere with respiration during the anaes-

thetic. (e) A new saddle is obtained for use after the operation, unless a plaster bed is being used.

On the evening prior to operation, the patient is given an enema. He is then turned, and the skin of the whole back prepared with an antiseptic according to the surgeon's wishes, and covered with sterile towels kept in position by tapes. If a graft is to be taken from the leg it is shaved and prepared in the same way On the morning of operation, he is given a light breakfast and after premedication, is taken to the anaesthetic room accompanied by his turning-case the necessary straps, and the new saddle. The operation is carried out as the patient lies in his turning-case the patient is then turned on to his frame and new saddle (or plaster bed if this is used) and a club-foot shoe applied to the lower limb if a graft has been taken.

Post-operative nursing care. Shock is often marked after operation on the spine. Salines and blood transfusion may be necessary and sedatives, warmth and quiet are essential. The pulse is recorded hourly Sips of water may be given when the patient recovers consciousness. Loss of movement of the toes must be reported to the surgeon at once After about ten days, the patient is turned and the stitches removed. After spinal fusion, frame fixation is continued for three to six months thereafter the patient is fitted with a plaster jacket or spinal support, and after a preliminary period of mobilising in bed, is allowed up On discharge, relatives are instructed in the care of the support. The patient is either re-admitted to hospital from time to time for review or he is supervised at an After-care Centre The support may later be gradually discarded.

CHAPTER XI

TUBERCULOSIS OF THE HIP JOINT

Symptoms and signs. Thomas' test for flexion contracture. Real shortening. Apparent shortening. Aims of treatment. Treatment. Splintage. Skin-extensions. Method of application. Temporary extension. Pugh traction. Daily nursing care. Immobilisation on an abduction frame. Immediate nursing care. Daily nursing care. Treatment of the groin. Pressure sores under a groin trap. Maintenance of correct position. Treatment of extension sores. Unna's paste extensions. Deformities. Turning a patient on an abduction frame. X-ray examination. Later treatment. Later treatment in children. Gradual mobilisation. Weight and pulley traction. Nursing care. Broomstick plasters. Nursing care. Plaster spica, patten and crutches. Plaster spica with weight bearing. Compensation for shortening. Block leather spica. Nursing care. Thomas' hip-splint. Operative treatment. Preparation for operation. Post-operative care. Later treatment in adults.

THE hip-joint is more often attacked than any other single joint and is second only to the spine. The lesion may be synovial only, especially in childhood, or it may be situated in any of the constituent bones of the hip-joint with erosion, destruction and formation of cavities.

Symptoms and signs. (1) *The general symptoms and signs* are already described. (2) *Local symptoms and signs.* A limp is almost always the first symptom, and becomes more marked when the patient is tired. Pain may be felt in the hip-joint itself or it may be referred along the course of the obturator nerve to the knee, especially in children, in whom this is a very common and misleading symptom. In childhood, when the cartilage has been eroded and sub-chondral bone exposed, there will be a history of disturbed sleep and night-cries. This is due to the relaxation of protective muscle-spasm during sleep. Muscle spasm is an effort on the part of nature to immobilise an inflamed joint. During sleep the muscles relax their guard, the sensitive joint surfaces rub together and the child wakes with a characteristic sharp cry. Immediately protective spasm reappears and the child drops off to sleep again. *The orthopaedic nurse on night-duty must always be on the alert for such cries and must report them at once, as their occurrence during treatment is indicative of inadequate immobilisation.*

Examination of a suspected hip is carried out in the following manner —(1) Inspection. (2) Palpation. (3) Test of movement (4) Measurements. (5) X rays.

Inspection The patient lies on a firm couch *in an early case* the hip will be held in flexion, abduction and external rotation. This is due to protective muscle spasm, and to the fact that it is in this position that there is most room in the inflamed joint it is the position of rest gives maximal synovial space and pressure within the joint is relieved.

Palpation may reveal swelling and thickening around the hip and perhaps local tenderness.

Test of movement will reveal limitation of all movements in all directions by pain and muscle spasm.

Comparative measurements at this stage often reveal apparent lengthening Measurements taken round the thighs at the same level may reveal muscle-wasting and there may be wasting of the buttock.

X rays In a very early case, there may be no X ray changes at all, but as the X ray appearances always lag behind the inflammatory process, the case is diagnosed and treated on the clinical signs only *Both hip-joints must be X rayed for purposes of comparison*

Osteoporosis (the bones appear decalcified, i.e. less dense to X rays than normal bone) is an important early sign. It may be present throughout the joint or be confined to the site of the original focus.

In a later case where muscle spasm has continued over a longer period, the pull of the powerful adductors combined with habitual lying on the unaffected side produces adduction and internal rotation, but the flexion remains Palpation may reveal swelling and tenderness, or even abscess formation. Measurements at this stage usually show apparent shortening X rays may show evidence of [illegible] Later still in addition to any or all of the above signs there may be an extreme lumbar lordosis indicating flexion contracture of the hip The surgeon will determine whether or not this is present by Thomas test Measurements may reveal real shortening indicating destruction or dislocation of the hip Gross des-

truction of the acetabulum causing it to wander may result in a pathological subluxation of the femoral head.

Thomas' test for flexion contracture of the hip. The patient lies on a firm couch. The sound limb is flexed on to the abdomen until the lumbar lordosis is obliterated. This position is then held, and if the patient cannot lay the affected leg flat on the couch flexion contracture is present. (Fig 126.)

Real shortening is due to destruction or displacement of bone. *Measurements* The patient lies on a firm couch. The anterior *superior spines of the ilia must be level. Mark these bony*



Fig 126.
Thomas test for flexion contracture of the hip.

points and the upper border of the medial malleoli. Any difference in measurements between these points constitutes real shortening

Apparent shortening is due to pelvic tilt. *Measurements.* The patient lies on a firm couch, with the legs in the position in which they are habitually held. Mark the medial malleoli. Measure from the umbilicus to the points marked. If there is no *real* shortening apparent shortening of the limb indicates *adduction* On the other hand, apparent lengthening indicates *abduction*

Aims of treatment. (1) *In children* to induce healing with either —(a) full free movement, or (b) sound ankylosis in the best possible functional position. (2) *In adults* to induce healing with sound ankylosis in the best possible functional position. A tuberculous hip-joint which is neither freely movable nor

soundly ankylosed is unsafe and is liable to become the seat of chronic grumbling disease

Treatment. (1) *General treatment* has already been described. (2) *Local treatment* In the early stages this is standard for both adults and children, and consists of immobilisation of the affected joint in the position of choice

Splintage. (1) A Jones abduction frame with skin extensions. (2) A plaster bed, with extension-bows and a bar to provide fixation for the groin-strap incorporated skin extensions. (3) A plaster spica either single or double

The nursing care of a patient in a plaster spica is described elsewhere (Chap IV) If used in the early stages of treatment a double spica is usually ordered, as a single spica does not prevent adduction deformity As a general rule it is used only in the late stages of treatment or if complications such as renal infection render frame-fixation undesirable, or if the skin is so delicate as to counter indicate skin-traction. In most cases, *traction over a long period is considered the most satisfactory* method of treatment. A plaster bed is used if there is deformity of the spine or if the patient is so misshapen as to render fixation on a frame and saddle impossible The nursing care is similar to that necessary for a Jones abduction frame, which will now be described.

In very acute cases, it may be necessary to apply extensions and frame-fixation under an anaesthetic. The frame may be single or double but if more than 15 20 abduction of the hip is indicated a double frame must be used. The single abduction frame permits of abduction of one limb only *and both hips must be equally abducted unless otherwise ordered*

The degree of abduction is decided by the surgeon and is governed by the clinical and X ray signs. As a rule the acutely inflamed hip-joint is nursed in the position which it has adopted, unless there is a great deal of adduction Wide abduction is necessary if there is danger of pathological subluxation and children as a rule require more abduction than adults. The method of measuring for an abduction frame and saddle is described in Chap X

The patient is generally allowed a day or so in hospital

before being fixed on his frame *If however the condition is acute and painful, immobilisation must be carried out at once.* The nurse who has once seen the dramatic result of prompt immobilisation of an acutely inflamed hip-joint will lose no time in anticipating the surgeon's wishes, and preparing skin extensions and a frame immediately the patient is admitted. Even if the condition is not acute it is a bad policy to allow a patient with an inflamed hip-joint to lie in bed for several weeks whilst a frame is being made A suitable temporary frame *must* be found, or Pugh's traction can be applied as a temporary measure

Preparation of the patient for frame fixation. The patient is prepared as for a straight frame (Chap. X.) In addition, skin-extensions are applied to both legs, preferably overnight *or at least a few hours prior to fixation Cleanliness of the skin* is essential but shaving of the limbs is unnecessary

Skin extensions. (1) *Measurements.* The patient lies on a firm couch. Measure (a) from the great trochanter to 1½ ins above the external malleolus (b) round the thigh at the level of the great trochanter (c) round the ankle 1 in. above the external malleolus. (2) *Making extensions.* Lay a roll of Holland strapping on a table Rule out measurement (a) = total length. Rule out measurement (b) = total width. Cut into two equal halves Divide measurement (c) into two, and mark in the middle of the strapping at the lower border Rule and cut down to these two points. The inner extension will obviously be cut 2-3 ins. shorter than the outer one Cut a small square out of the lower end of each extension and sew a loop of lampwick firmly on to the sticky side Holding the extensions loop-end down, slit the sides obliquely downwards and inwards so that they can be moulded to the shape of the limbs. Hang them up in the air for a short time as this helps to make them stick.

Method of application. *Prepare a tray with the extension* gauze bandages, needle and cotton bottle of Tinct. Benz. Co. cotton wool and receiver splint wool and bandages. (Fig 127.) The patient lies on a firm couch covered except for the legs. The limb is steadied throughout by an assistant N.B.

Exercise great care in handling the limb even if it is not conspicuously painful maintain gentle traction avoid pump-handling this not only irritates the joint but may cause dissemination of tuberculous bacilli to other parts of the body Paint the whole surface of the limb with Tinct. Benz. Co. This not only assists in making the extensions adhere quickly and

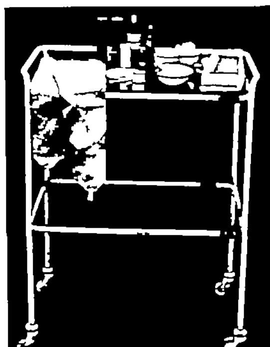


Fig 1.
Trolley set f application of Holland strapping skin extensions

closely to the skin, but is a safeguard against their irritating effect. Take two turns of gauze bandage round the ankle just above the malleoli turn it over and stitch down without a knot This is to prevent friction between the skin and extension loops Apply the inner extension first Hold the sticky side in front of a radiator or fire moving it about until the whole surface glistens *It must not be heated so that the glue comes through in dark patches on the other side* Overheating will cause extension sores. Place the loop just above and behind the internal

malleolus and quickly smooth the extension on to the leg *There must be no creases* or extension-sores will form. Apply the outer extension in the same way (Fig 128.) The extensions should overlap smoothly at the back but not in front, and the patella and crest of the tibia must always be left free for inspection. Continue the bandage up the leg in spiral turns, making sure that no tight strands are present which might impede the circulation of the limb. The patella is not covered by the bandage Finish off by stitching the end down neatly (Fig. 129)



Fig 128.
Application of Holland strapping skin extensions. Note that the arm maintaining traction on the leg is comfortably seated.

In no circumstances is an extension covered by a stiff bandage or piece of strapping This may dig into the limb and cause sores, or it may interfere with the blood or nerve supply to the limb. Only soft gauze bandages are used, and figures of eight or other turns are not recommended. The bandage should be lightly applied in plain spiral turns, each turn overlapping about *half of the previous one* *If an extension* is covered by a thick bandage sores beneath it may pass unnoticed.

Except in an emergency skin extensions are not tied immediately. A temporary extension may be applied. While an assistant steadies the limb, roll several pieces of splint wool and felt round the ankle just above the malleoli. Tie a bandage over them in a clove-hitch, and tie to the extension bows. (Fig 130.) If this type of temporary extension is used, the foot must be inspected frequently for signs of swelling blueness, and loss of movement, and *no complaint of pain or pressure must be ignored*, or a drop-foot may result. A temporary extension should not be left on overnight as it constitutes a grave menace to the blood supply of the foot especially in cold weather. If for some reason it must be left on, the night nurse is instructed

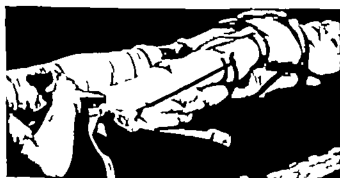


Fig 129

The completed extension. For the sake of clearness a piece of black paper has been placed between the skin and the knot.

to inspect the foot at hourly intervals and to report on its colour and movement. If the extensions are being applied prior to frame-fixation, metal back splints must be bandaged on to the legs to prevent flexion of the knees and crinkling of the extensions. Sufficient padding must be placed under the knee to prevent hyperextension. When the extensions are ready for tying, fasten a length of lampwick through the loops with a slip knot. (Fig 129.)

Pugh's traction may be ordered, until the frame arrives, and is applied in the following manner —

After applying the skin extensions, well padded back splints are applied to the legs, extension ties of sufficient length are attached to the extension loops, and tied to the end of the bed,

or to a special wooden cross-bar. The knees must be held in 5° flexion. In the original Pugh bed, the knees were supported in flexion by a piece of wood inserted beneath the mattress, and back splints were not used. *It has been found, however* that the skin-extensions last longer if covered by bandages and splints, and are not easily interfered with by the patient. The foot-end of the bed is then elevated, either on a chair (if it is merely a temporary measure) or by special upright supports (Fig. 131.) This should always be done if the Pugh's traction is to be maintained over a long period, as it facilitates moving the bed from place to place without interfering with the traction.



Fig. 130.
Method of applying temporary extension by means of a clove hitch over a pad of felt and wool. Lampwick has been used instead of bandage for the sake of clearness.

If a chair or block is used to elevate the foot of the bed, the nurse must never remove it, or all traction on the inflamed joint will be lost.

Daily nursing care. After the routine toilet, remove the leg bandages, inspect the extensions, and see that there is sufficient packing under the knee to prevent hyperextension. See that the back-splint is not pressing into the thigh or the calf, that the extension tapes do not chafe the ankles or feet, and that the feet are warm, of good colour and moving freely. The heels must not press into the bed, and bed clothes must be supported. Examine the patient for swelling or deformity. Pugh's traction exerts no control over pelvic tilt, and it is for this reason that it is as a rule ordered only in the very early or late stages of treatment. Apart from this, it is not an agreeable position for the patient. Copious fluids must be given and the urine

tested regularly as the position prevents proper drainage of the kidneys.

Preparation of the frame. Remove saddle and guards. The degree of abduction is adjusted according to the surgeon's orders, by moving the joints of the frame as described in Chap V. Bind the frame in the manner already described. In addition, cover all screws with a little wool and adhesive strapping to prevent them from becoming loose and to protect the bedclothes.



Fig 131
Pugh's traction.

Place the frame on a table with the saddle in position, but not the L. With a Lucas wrench *kink the pelvic-bar on the side of the unaffected hip and apply the guard and groin strap* (Fig 132). Apply the shoulder ties.

Immobilisation of a patient on an abduction frame

The patient lies on a firm couch. Five operators are necessary. Nurse 1 takes up her position at the bedside holding the frame with saddle in position level with the patient's body. Nurse 2 stands at the head of the bed and grasps as previously described for tuberculosis of the spine (Fig 90). Nurse 3

sion ties must be kept taut at all times they must *never* be loosed unless an assistant is holding the limb above the knee in order to maintain traction, as shown in Fig 133. The groin-



Fig 134.
A patient immobilised on a Jones double abduction frame for tuberculosis of the left hip.



Fig 131.
Showing the moulding of the bars and the attachment of the groin strap. The legs are bandaged their entire length. Note that the right knee is in correct position, fitting closely in the long axis of the limb. The left one is incorrectly moulded and is standing away from the limb.

strap must *never* be unfastened unless counter traction is provided. This is done either by an assistant exerting traction on the shoulders, or by elevating the foot-end of the bed so using the patient's own body weight to provide the counter traction. Flexion contracture if present will be reduced by the traction.

the lumbar spine will settle on to the saddle and readjustment of the pelvis bars will be necessary. The extension ties must be inspected frequently as the lampwick may stretch.

The daily toilet is carried out as for a straight frame. After washing the exposed surfaces of the body pay special attention to the area under the groin-strap.



Fig. 136.

Strong traction and wide abduction is necessary if there is upward subluxation of the femoral head. Note that the frame is tied to the elevated foot-end of the bed. In this case a 6 in. nail is passed through the extension tapes as a Spanish windlass to ensure strong traction. This is necessary only in exceptional cases.

To treat a groin. Raise the foot-end of the bed on a block or a chair. Remove the groin-strap carefully so as not to pull on the skin, wash the areas beneath the strap and the external genitalia. Then, with a good lather of soap, rub the groin with a circular movement using the whole of the relaxed hand (Fig. 137). It is useless to polish the surface of the skin with the finger-tips. When the lather has been rubbed in and the skin is pink and smooth, dry and powder lightly. Too much powder will collect in little lumps under the strap and cause pressure. Cover the patient and treat the groin-strap. *Do not straighten it* or the leather will crack and cause sores. Clean the strap with a fairly dry well-soaped flannel. When it is perfectly clean, rub it in the same way as the groin, using plenty of saddle soap. Do not wet it too much. Powder when

dry and reapply it taking care not to damage the skin. A groin-strap which is perfectly clean, soft and smooth will not cause pressure-sores, and constant attention to this is as necessary as the treatment of the skin itself

Pressure sores under the groin-strap. The most usual site for a localised sore is the adductor tendon Once the skin has broken only the surrounding areas must be rubbed and the



Fig 137
Treatment of the groin by rubbing with soap and water is essential, to prevent sores *Note that the foot of the bed is elevated to provide counter traction.*

sore itself is treated with sterile dressings. Pressure can be relieved in the following manner —(1) By placing rolls of lint on either side of the sore and applying the groin-strap over them. They must be of sufficient thickness to prevent the groin-strap touching the sore (Fig 138.) (2) By making a plaster or leather guard to distribute the pressure as described for the shoulder straps of a back-support in Chap X. (3) By elevating the foot of the bed and temporarily removing the groin-strap This must only be done in extreme cases and the frame must be tied to the end of the bed by the cross-bar Very young or incontinent patients may require the application of grease instead

of powder. Zinc and castor oil ointment with the addition of sufficient Tinct. Benz. Co. to render it beige-coloured, has been found to be very useful. It should not be used unless absolutely necessary as it quickly ruins the groin-strap, making it black and soggy. If blisters should form beneath a groin-strap they should be aspirated and treated with sterile dressings. It is always advisable to keep two groin-straps for a child or an incontinent patient.



Fig. 138
Pressure of the groin-strap on a localised sore is relieved by placing lint rolls on either side of the sore.

To give a bed pan to a patient on an abduction frame. This is given as to a patient on a straight frame. It is not good nursing to elevate the foot of the bed and remove the groin-strap as urine and faeces may track upwards and ruin the saddle. Female patients should be taught to use a urinal, and cleansing is done in the same way as for a straight frame. Adult patients are nursed on section mattresses as described for a straight frame.

Maintenance of correct position. The patient is inspected daily to see that the tip of the coccyx approximates to the fork of the saddle and that the ischial tuberosity rests in the gluteal bend of the frame. If incorrect the patient must be adjusted forthwith.

Procedure. Four nurses are necessary. Remove the

bandages and shoulder ties and bend back the nipple bars. Nurse 1 exerts traction under the shoulder blades as previously described. Nurse 2 steadies the affected limb. Nurse 3 the unaffected one. Nurse 4 then unties the extension tapes, removes the groin-strap and bends back the pelvic-bars. She then grasps the pelvis, and at her command the patient is lifted up or down the frame. The pelvic bar on the unaffected side is then adjusted and the groin-strap applied. Nurse 1 can now release her hold. Nurse 4 then grasps the affected limb above the knee and exerts smooth gentle traction while Nurse 1 ties the extension. Similar traction is exerted on the unaffected limb and the extensions are tied. The extensions should be tight enough to twang like a violin-string. *They must never be tied without traction being exerted on the limb above the knee* or the strapping will merely be stripped off the skin and no real traction obtained. The pelvic-bar is then adjusted on the affected side. The anterior superior spines of the ilia must be exactly level at all times. Pelvic tilt will result in compensatory deformity of the spine. Place the thumbs on the anterior superior iliac spines and see that they are in the same line. The patient can be taught to do this.

Tilting of the pelvis may be due to one of the following:—

(1) Extensions being tighter on one side than the other. If so, tighten the extension on the side on which the pelvis is raised.

(2) Pressure of the groin-strap. The groin-strap should be tight enough to press against the groin but not so tight as to produce a deep groove in the skin. The patient may tilt the pelvis down on the unaffected side in an effort to escape the pressure of the strap. In cases where a second groin-strap is necessary to secure immobilisation (e.g. in young and lively children) it must never be so tightly applied as to press on an acutely inflamed hip-joint.

The limbs are then examined for swelling or deformity. Special care is needed in supporting the knees. Subluxation is even more likely to occur than in the straight frame as the traction tends to pull the knee into hyperextension.

The extensions must be inspected for signs of sores, and no complaint of irritation or pain under them must be ignored.

The presence of a sore may be indicated by rise of temperature by disturbed sleep, and finally by an unpleasant smell or an offensive discharge Any patient with extensive sores is liable to toxic absorption and albuminuria The urine must be tested and copious fluids given the bowels must be kept open. In patients whose skins contain very little pigment extension sores may become so severe and intractable that a plaster spica is substituted for frame fixation, but this is an admission of failure and is only employed as a last resort

Treatment of extension sores. A localised sore is easily dealt with by cutting a hole round it in the strapping and applying a sterile dressing Sloughing sores requires a Eusol dressing until the sloughs separate Thereafter a simple dry dressing is usually adequate A generalised skin irritation under extensions is more troublesome and may necessitate removal of the extensions. A temporary extension (Fig 130) is then applied, but the dangers of its use have already been stressed, and new extensions must be applied at the first possible movement A generalised skin irritation will often heal quickly if the skin is cleansed with saline and the limb exposed to the air The application of Calamine lotion or of cod liver oil compresses may prove effective In cases which do not tolerate Holland strapping extensions made of Taylor's perforated zinc-oxide strapping may be used instead. These have the added advantage of adhering quickly to the skin, so that they can be tied almost immediately Alternatively Unna's paste extensions may be applied.

To apply Unna's paste extensions. Melt the Unna's paste by standing the jar in a saucepan of water over a gas-ring. It must be comfortably warm to the hand but not hot enough to burn the patient Prepare extensions of strong old linen or cotton material cut out exactly as for the strapping ones, but do not split the sides. It is advisable to make them of *double thickness. The bedclothes must be protected while the* extensions are being applied. While an assistant steadies the limb, paint its entire surface with the melted paste Apply a gauze bandage around the ankle as previously described, then dip the prepared linen extensions in the paste and apply them quickly and smoothly to the limb (Fig 139.) If made of

double thickness, the gauze bandage can be applied over one layer then more paste applied, and the second layer treated in the same way This makes a more durable extension. The patella is left free and the whole extension covered with a gauze bandage. A temporary extension is applied for at least twenty four hours, or until the Unna s paste has set firmly enough for the lampwick ties to be inserted in the loops and tied in the ordinary manner



Fig 139.
Application of Unna's paste extensions.

The ankle must be inspected daily as the Unna s paste tends to stand away from the skin after a time, and as traction is applied to it, slips down the limb and may cause pressure behind or in front of the ankle-joint

The feet. When the toilet is complete and splintage adjusted, inspect the feet Be certain that full movement is present and that they are warm and of good colour especially if corrective bandaging of any kind is used. Foot exercises will be given by a physioth

Deformities. The pa develop any deformities mentioned in ec a straight ones specially to be gu :—(1) T pelvis. (2) External or int at the hip

recurvatum or genu valgum. (4) Talipes cavo-varus Children must be specially watched for this as they curl their feet inwards under the extension bows.

Turning a patient on an abduction frame

Patients with tuberculosis of the hip-joint must not be turned unless it is absolutely necessary, as some movement at the hip-joint and interference with traction is certain to occur It is preferable in most cases to elevate the foot-end of the bed, remove the patient en masse from the frame and tie the extensions to the end of the bed (as in Pugh s traction) for

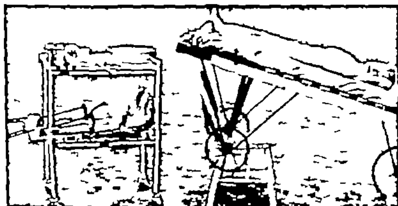


Fig 140.
Cases of tuberculosis of the hip joint should not be turned unless it is absolutely necessary The patient is lifted from the frame and the extensions are tied to the elevated foot end of the bed. Adjustments to the frame can then be made without harm to the patient.

such procedures as cleansing, adjustments and repairs to splintage to be carried out (Fig 140) If however renal complications or some other condition make turning a dire necessity it is carried out in the following manner —

The turning case is made with extension bows and bar for the groin-strap incorporated. After placing the straps in position, remove the clothing and bandages elevate the foot end of the bed, and unfasten the groin strap Cover the patient with splint wool and place the turning case in position, strapping it on firmly Fasten the groin-strap to the turning case Turn in the usual manner Holding the extension tapes as steadily

double thickness, the gauze bandage can be applied over one layer then more paste applied, and the second layer treated in the same way This makes a more durable extension. The patella is left free and the whole extension covered with a gauze bandage. A temporary extension is applied for at least twenty four hours, or until the Unna's paste has set firmly enough for the lampwick ties to be inserted in the loops and tied in the ordinary manner



Fig 189
Application of Unna's paste extensions.

The ankle must be inspected daily as the Unna's paste tends to stand away from the skin after a time, and as traction is applied to it, slips down the limb and may cause pressure behind or in front of the ankle-joint.

The feet. When the toilet is complete and splintage adjusted inspect the feet. Be certain that full movement is present and that they are warm and of good colour especially if corrective bandaging of any kind is used Foot exercises will be given by a physiotherapist.

Deformities. The patient may develop any or all of the deformities mentioned in connection with a straight frame. The ones specially to be guarded against are —(1) *Tilting of the pelvis.* (2) External or internal rotation at the hip (3) Genu-

recurvatum or genu-valgum. (4) Talipes cavo-varus. Children must be specially watched for this as they curl their feet inwards under the extension bows.

Turning a patient on an abduction frame

Patients with tuberculosis of the hip-joint must not be turned unless it is absolutely necessary, as some movement at the hip-joint and interference with traction is certain to occur It is preferable in most cases to elevate the foot-end of the bed, remove the patient en masse from the frame and tie the extensions to the end of the bed (as in Pugh s traction) for

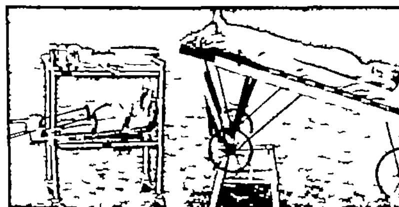


Fig 140.

Cases of tuberculosis of the hip-joint should not be turned unless it is absolutel necessary The patient is lifted from the frame and the extensions are tied to the elevated foot-end of the bed. Adjustments to the frame can then be made without harm to the patient.

such procedures as cleansing adjustments and repairs to splintage to be carried out (Fig 140) If however renal complications or some other condition make turning a dire necessity it is carried out in the following manner —

The turning case is made with extension bows and bar for the groin strap incorporated After placing the straps in position remove the clothing and bandages elevate the foot end of the bed, and unfasten the groin strap. Cover the patient with splint wool and place the turning case in position, strapping it on firmly Fasten the groin strap to the turning case Turn in the usual manner Holding the extension tapes as steadily

as possible in order to maintain traction, tie them on the extension bows of the turning case. Proceed as for a straight frame When the procedure for which the turning has been carried out is finished, apply the saddle and frame to the patient's back. Turn in the usual manner and re-tie the extensions to the extension bows of the frame. Replace the bars, groin-strap, bandages and clothing and lower the bed. Leave the patient comfortable.

To X-ray a patient on an abduction frame

Four or five assistants are necessary depending on the size of the patient If the condition is acute, it must be the responsibility of one person to steady the affected leg The traction is not released except by the surgeon's orders. The patient is laid on the X ray table on his frame and the leg-bandages and shoulder ties are unfastened Four assistants then take up their positions one grasps the affected leg another the sound leg, another the shoulders, and a fourth will lift the pelvis. The extensions are untied the groin-strap removed, and at a command the patient is lifted en masse a fifth assistant quickly removes the frame from beneath the patient, and he is laid smoothly and gently on to the table Traction on the hips and shoulders is maintained throughout. After the X ray has been taken, the patient is replaced on the frame and made comfortable In small children, it may be possible to take an X ray without removing the frame. While an assistant exerts traction on the shoulders, or while the foot of the X ray table is tilted the groin strap is removed and the pelvic-bars bent back. The casette is then inserted between the patient's pelvis and the saddle.

LATER TREATMENT OF TUBERCULOSIS OF THE HIP JOINT

Frame fixation and traction is continued until there is clinical and radiographic evidence of quiescence of the lesion. The general indications for the termination of fixation are as already described for tuberculosis of the spine The later treatment will then depend on whether the aim of treatment

(1) *Healing with full free movement of the joint* or (2) *healing with sound ankylosis in the best possible functional position*

In general it is considered advisable to aim for movement only in those cases in which the joint has escaped gross destruction, and in which at least a semblance of normal joint surfaces remain. As a rule this is possible only in children whose period of general treatment and frame fixation may be continued for a very long period, often two to three years. In adults, the period of fixation is often only a prelude to operative measures, though it is essential in order to combat the systemic disease and to secure quiescence of the local lesion.

Later treatment in children

If it is decided that the aim is to be (1) **healing with full free movement,** the following measures may be adopted —

Free mobilisation. The patient is either removed from the frame altogether and allowed to mobilise the legs freely over pillows, or the extensions may be loosed for increasing periods each day until the frame is gradually discarded. Exercises for the general musculature, to strengthen the legs and regain flexion of the knees, are practised intensively but *formal exercises to the affected joint should not be given* as any forced movement is contraindicated.

If pain spasm, flexion contracture or rise of temperature should occur indicating that all is not well with the joint, fixation is immediately reapplied. If however none of these signs arise and free movement quickly returns, weight bearing is gradually resumed, and the patient is eventually allowed home without splintage.

Pugh's traction, followed by free mobilisation The method of applying this, and its nursing care has already been described. Sitting up is gradually introduced and a careful watch must be kept for kyphosis and scoliosis. When movement of the affected joint is regained, the patient is allowed a period of free mobilisation in bed and weight bearing i gradually resumed.

Weight and pulley traction, followed by free mobilisation.

Application. A wooden cross-bar is attached to the end of the bed directly above the mattress and fitted with small pulleys in line with the lower limbs. Strapping extensions are attached to a spreader and to a cord which runs over the pulley carrying a small weight, as shown in Fig. 141. The foot-end of the bed is then elevated to provide counter traction and the patient is encouraged to pull the weight over the pulley.



Fig. 141.
Simple weight and pulley traction.

Nursing care. The extensions are inspected daily and the knees must not become hyperextended. See that the cord does not slip off the pulley and that the weight does not rest on the floor. If no untoward signs arise the patient may be allowed free in bed, and eventually weight-bearing is resumed without splintage.

Broomstick plasters, followed by free mobilisation. Well-moulded plasters are applied to both legs from the toes to the groin and fixed to a broomstick by means of a plaster bandage.

(Fig. 142.) Sitting-up is gradually introduced, and flexion of the hip-joint regained.

Nursing care The plasters are inspected daily for cracks and for signs of pressure-sores. Broomstick plasters can give rise to certain complications unless the patient is nursed with unceasing vigilance

(a) *Scoliosis.* If the child sits up unsupervised or too soon, he will rotate the pelvis forwards on the unaffected side due to limitation of flexion in the affected hip. A curve of the lumbar spine will then follow with a compensatory dorsal curve above, and scoliosis results.



Fig 14_
Broomstick plasters.

(b) *Kyphosis* The general musculature is always weak after frame fixation. If sitting up is unsupervised and the back muscles are not strong enough to maintain the upright position, the child crouches in bed and a kyphosis results.

(c) *Lordosis* may be compensatory to kyphosis or flexion contracture of the hip or to stretching and weakness of the abdominal muscles.

(d) *Flexion contracture of the hip* In the sitting position, the hip flexors are shortened and prolonged sitting in any splint will lead to contracture of these muscles.

(e) *Genu recurvatum* Some laxity of the knee-joints is almost certain to occur as the hamstrings are constantly on the stretch in the sitting position, but genu recurvatum can be largely prevented by the application of very carefully moulded plasters holding the knees in slight flexion.

(f) *Genu valgum or genu varum* can be prevented by correctly moulded plasters.

(g) *Foot deformities* can be prevented by correct moulding of the plasters and by free movement of the toes.

Exercises for the spinal, abdominal and gluteal muscles are practised intensively and the patient should spend part of each day lying on his face (Fig. 142.) When flexion of the hip has been regained, the patient is allowed to kick free in bed with pillows under the knees, and is eventually allowed up without splintage.

Aim 2—healing with sound ankylosis in the best possible functional position. Treatment directed to this may be either *conservative* consisting of retentive splintage with or without weight bearing until spontaneous fusion has occurred, or *operative* treatment may be advised.

Retentive splintage. (1) Plaster spica, patten and crutches. (2) Plaster spica direct weight-bearing. (3) Block leather spica. (4) Calliper (sometimes). (5) Thomas hip splint (sometimes).

Plaster spica, patten and crutches. The plaster spica may be single extending below the knee or including the foot or it may be double if more fixation is desired. The plaster spica is applied and dried as described in Chap. IV and the patient is encouraged to roll about in bed. Exercises are given by a physiotherapist to regain flexion of the free knee and to strengthen the arms preparatory to using crutches. Meantime crutches are ordered and a patten is applied to the boot of the unaffected side. The height of the patten varies with the size of the patient. For a child, 3 ins. at the heel sloping to 2½ ins. at the toe is usually sufficient but it must be remembered that though a high patten makes for an unsteady gait one which is too low will allow the patient to take weight on the toes of the affected side.

To measure for crutches. The patient lies on a firm couch with his arms to his sides. Measure from the axilla to the heel of the boot and add sufficient to allow for the patten. Crutches must be exactly the right length. If they are too long the patient may develop a crutch-palsy. If they are too short he stoops over them and develops a kyphosis. When the general

musculature is good and flexion of the free knee has been regained to at least 90 weight bearing is gradually introduced. A physiotherapist will get the patient up for short periods several times a day to avoid fatigue Exercises, particularly quadriceps drill, are continued, and standing and balancing on the crutches



Fig 143.
Plaster spica, patten and crutches.



Fig. 144.
Compensation for shortening

must be taught before actual walking i commenced (Fig 143.) If th patient is to be discharged in this apparatus, he must be taught to get on and off his bed una sisted and to negotiate st ps *On discharge* the nurse must instruct the patient s relatives in the care of the plaster He is either supervised at an After-care clinic or re admitted to hospital for review after a few months.

Splintage with weight-bearing Some patients may be allowed to weight-bear in plaster without crutches after transfixation (after a preliminary period of kicking about in bed) depending on the individual case or direct weight-bearing may be ordered after a period on crutches, if the general health remains good and the X rays show further healing. The patient may continue to wear a below knee plaster spica, or it may terminate above the knee During the change from a below-knee to an above-knee spica the patient must regain 90 flexion of the newly freed knee before weight-bearing is introduced. Any patient wearing an above-knee spica must be watched for genu valgum and it may be necessary to raise the inner side of the heel of the boot.



Fig 145.
The shoe is raised to compensate for shortening of the limb. A layer of cork is placed between the upper and the sole

Compensation for shortening Real shortening of ½ in. or less can safely be ignored but more than this must be compensated for by raising the foot wear or deformity will result. To ascertain the amount of raising required, the patient stands upright and graduated wooden blocks (¼ in., ½ in., 1 in., etc.) are placed under the foot of the affected side until the anterior superior spines of the ilia are level. (Fig 144) The amount ordered is generally ½ in less than the amount of real shortening and the heel of the boot is usually raised ½ in. more than the sole for example a patient with 2 ins. real shortening may require 1½ ins. raising to heel, and 1 in. to sole. The boot is

raised by layers of cork placed between its upper and sole (Fig 145)

Block leather spica. After a further period of weight bearing in plaster the surgeon may decide to substitute a block leather spica for the plaster This is made as described in Chap IV It may be made in two halves, or laced down the centre or down one side only and it may terminate above or below the knee (Fig 146)





A. Fig 146. B.
Moulded block-leather spicas used in the late treatment of tuberculous of the hip.

Application The patient is lifted en masse into the block leather

Daily care of a patient in block-leather spica Four hourly treatment of pressure points must be carried out when the splint is first applied once or twice daily is usually sufficient once the skin has become accustomed to it After the routine toilet remove the top half of the block leather by undoing the

lacings. Wash the exposed surfaces, and treat all pressure points (e.g. the iliac spines) with soap and water. It may be necessary to pad them off with felt, or to hammer out the block leather a little. Lace the block leather, turn the patient on to his face and treat the back in the same way. Inspect the spica daily for signs of wear. It is always advisable to keep the bivalved plaster from which the patient has been removed, so that it can be worn should alterations or repairs to the block-leather become necessary.

A caliper. In some cases a caliper may be ordered to afford some protection to the hip-joint. This is applied as described in Chap. XII. and the same care is needed.

Thomas hip-splint. (Fig. 31.) This is rarely used nowadays, but it may be ordered in cases where there are multiple sinuses which render the wearing of a plaster or block leather spica impossible. It is usually combined with crutches. As it exerts no control over pelvic tilt the patient must be closely watched for progressive deformity.

Operative treatment. When a child has reached a suitable age (about nine years) and it is thought that in spite of prolonged treatment bony union will not occur, operative treatment may be considered. Operations are performed for the following purposes:—(a) To correct deformity and promote healing (osteotomy). (b) To fuse the hip-joint (arthrodesis). (c) Operations are also performed to adjust the length of the limbs (leg shortening or leg lengthening), especially if there has been interference with epiphyseal growth at the knee-joint.

Preparation for operation. The general health must be at a high level and investigation of the urine, the blood and chest condition is carried out as for a tuberculous spine. If a graft is to be taken from the tibia, the knee is mobilised until at least 90° flexion is obtained. An area of skin from the nipple line to the toes, and including the area from which the graft is to be taken, is shaved and prepared according to the surgeon's wishes. After operation, either a single or double plaster spica is applied. The surgeon will hold the limb in the position he desires whilst the plaster is applied.

Post-operative care. *On return from* the theatre in addition to the routine treatment for shock the plaster is dried as set out in Chap IV and the amount of oozing of blood through the plaster is noted The extremities must be watched for circulatory interference After *arthrodesis* a double plaster spica is worn until there is some degree of union. This will later be changed to a single spica, and weight bearing may be introduced after about six months, depending on the degree of union in the individual case When union is complete and flexion of both knees has been regained to at least 90 weight bearing without splintage is introduced. *After osteotomy a* single plaster spica is worn for about three months. Exercises are then commenced, and the patient allowed up

Later treatment in adults

Conservative treatment *may be continued either as a preliminary* to operative interference or because the presence of some complication (e.g discharging sinus) contraindicates operation. Retentive splintage may then be ordered as already described for children.

Operative treatment (i.e. either osteotomy or arthrodesis of the hip) is more frequently advised in adults than in children, because the aim is sound ankylosis in any case and if there is no sign of this occurring by conservative methods, operation is advised. Also, operative interference may shorten the period of hospitalization, which is highly desirable in the case of an adult.

CHAPTER XII

TUBERCULOSIS OF THE KNEE JOINT

Symptoms and signs. Aims of treatment. Splintage. Thomas bedsplint and guarding splints. Application of skin extension. Guarding splints. Application of bedsplint and guarding splints. Daily nursing care. Pressure-sores under a bedsplint ring. Daily care of splintage. X-ray examination. Later treatment in children. Application of calliper and guarding plaster. Nursing care. Operative treatment in childhood. Later treatment in adults. Preparation for operation. Post-operative care

LIKE all other tuberculous lesions in bone this is always part of a generalised infection. As in tuberculosis of the hip-joint, the original site of infection is often in the synovial membrane and in childhood, may remain synovial only if treatment is promptly and efficiently carried out over a very long period. Later the infection may spread to the constituent bones of the knee joint with ulceration of the cartilage and destruction of the joint surfaces.

Symptoms and signs. (1) *General symptoms and signs* are as already enumerated. (2) *Local symptoms and signs.* In an early case loss of function is usually more noticeable than pain. The patient avoids putting his heel to the ground and the knee is held in slight flexion. Examination may reveal a hot and swollen knee, and the thickened synovial membrane feels peculiarly "doughy" on palpation. Wasting of the thigh muscles renders the appearance of the swelling more noticeable, and gives the limb a fusiform appearance. Movements of the joint are limited by pain and muscle spasm, and there may be local tenderness over bony points. *X-rays may* reveal generalised decalcification of the knee joint or the presence of an osseous focus. In a later case pain will be increased and continued muscle spasm may result in flexion contracture of the knee or pathological subluxation may occur.

The aims of treatment are :—*In childhood*—either (a) healing with full free movement or (b) healing with sound ankylosis of the joint in the best possible functional position. *In*

adults—healing with sound ankylosis in the best possible functional position. As in the hip-joint the knee is safe only when either freely movable or soundly ankylosed.

Treatment may be conservative or operative. *In adults* conservative measures are as a rule only a prelude to operative treatment but they are carried out in all cases in order to allow the patient to overcome the primary lymphatic infection before operation.

In childhood prolonged conservative treatment is always carried out before operation is considered.

As in the hip-joint, a long period of traction is generally considered the best method of treatment.

Conservative treatment is standard for both adults and children. It consists of general treatment as already outlined combined with fixation in the position of choice.

Splintage (1) Thomas bed-splint with skin extensions and guarding splints. (2) A plaster spica from the toes to the waist.

An acutely inflamed knee-joint must be immobilised at once. If it is impossible to obtain a bed-splint of the correct size a back-splint and club-foot shoe must be applied as a temporary measure.

Thomas' bed splint and guarding splints

The method of measuring for a Thomas splint is described in Chap. V Below-knee skin extensions are applied and allowed to adhere to the skin for a few hours before being tied.

To apply below-knee skin-extensions. *Measurements.* (1) From the head of the tibia to 1½ ins. above the malleolus. (2) Round the leg just below the knee (3) Round the leg just above the ankle.

Prepare the extensions as described in Chap XI and apply in the same manner An assistant steadies the affected limb throughout by grasping the foot. Apply a back splint and club-foot shoe to prevent the extensions wrinkling

Guarding splints. A bed-splint alone is not sufficient to immobilise a tuberculous knee guarding splints of some kind must be applied to prevent rotation strains. These may be —

(1) *Three metal back splints.* (Fig 42.) One rests on top of the slings and supports the limb. The other two are bent into a spiral to fit the limb and embrace it on either side. A club-

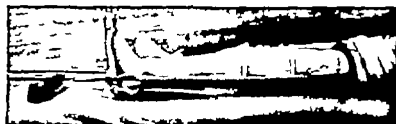


Fig 147

A Thomas bed-splint alone is insufficient immobilisation for an acute tuberculous knee. A metal back splint closely moulded lateral plaster slabs and a club-foot shoe are applied to prevent lateral movement and rotation strains. The bandage which encircles the splint has not yet been applied. It is shown i Fig 149



Fig 148.

Thom bed splint with anterio and posterior plaste shells. The anterior shell ha been removed for inspection of the knee.

foot shoe may be used in e with metal splints. See that it is not pressed so e sole of the f as to interfere with the traction *back-splint* r

lateral splints with or without a club-foot shoe. Two plaster slabs are closely moulded to each side of the knee, and are used in the same way as the metal side-splints. (Fig 147) (3) *Anterior and posterior plaster shells* A plaster cylinder is applied over stockinette in the usual way Particular attention is paid to moulding of the plaster and the knee is supported in slight flexion. When set the cylinder is cut down each side, but not removed until it is dry This method of applying guarding splintage has been found most satisfactory especially in children. Though initially more troublesome in that the plaster splints must be very carefully made for each individual patient they are labour saving in the end and present the following advantages over other methods of guarding splintage (a) Once fitted, one can be certain that the correct position of the knee is constantly maintained. Hyperextension of the knee is prevented by the closely moulded posterior half of the cylinder and knock-knee is not likely to occur (b) The smoothly moulded shells do not cause pressure-sores, as may be the case if metal splints are used. (c) The knee can be inspected at any time without disturbing fixation, by removal of the top half of the cylinder (Fig. 148) (d) They are economical of material as no splint wool is necessary other than sufficient packed in on the outer side to prevent external rotation (e) Splintage including the foot is unnecessary except in very acute cases.

To apply the bed splint and guarding splints. Prepare a tray with bed-splint guarding splints, wool, bandages, and large pins. Two nurses are needed The patient lies (not sits) on a firm couch, and the affected limb is steadied throughout by an assistant. Great care must be taken in handling the limb While an assistant steadies the limb below the knee slip the ring of the bed-splint over the patient's foot The assistant then changes her grasp to the foot and exerts gentle traction. Grasp the splint in the right hand and push it gently up the limb As the ring reaches the thickest part of the thigh do not continue to ram it higher in such a manner as to pinch the skin. With the free hand, draw the skin and subcutaneous fat from under the ring, and finally press it firmly into the groin. *The bed splint ring must fit exactly* one which is too small will cause sores from pressure, one which is too large will cause sores from friction. Adjust the slings with large safety pins, not

(1) *Three metal back splints.* (Fig 42.) One rests on top of the slings and supports the limb The other two are bent into a spiral to fit the limb and embrace it on either side A club-

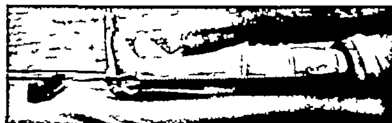


Fig 147

A Thomas bed-splint alone is insufficient immobilisation for an acute tuberculous knee A metal back-splint closely moulded lateral plaster slabs and a cl b foot shoe are applied to prevent lateral movement and rotation stra ns. The bandage which encircles the splints has not yet been applied. It is shown in Fig 149



Fig 148.

Thomas bed spl t with anterior and posterior plaster shells. The a teri shell ha been removed for i spection f the knee.

foot shoe may be used in conjunction with metal splints. See that it is not pressed so closely to the sole of the foot as to interfere with the traction. (2) *Metal back splint two plaster*

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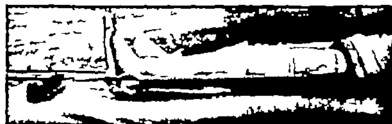


Fig. 147

A Thomas' bed-splint alone is insufficient immobilisation for an acute tuberculous knee. A metal back-splint, closely moulded lateral plaster shells and a club-foot shoe are applied to prevent lateral movement and rotation strains. The bandage which encircles the splint has not yet been applied. It is shown in Fig. 149.



Fig. 148.

Thomas' bed-splint with anterior and posterior plaster shells. The anterior shell has been removed for inspection of the knee.

foot shoe may be used in conjunction with metal splints. See that it is not pressed so closely to the sole of the foot as to interfere with the traction. (2) *Metal back splint, two plaster*

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To apply the bed splint and guarding splints. Prepare a tray with bed-splint guarding splints, wool, bandages, and large pins. Two nurses are needed. The patient lies (not sits) on a firm couch, and the affected limb is steadied throughout by an assistant. Great care must be taken in handling the limb. While an *assistant steadies the limb below the knee slip the ring* of the bed-splint over the patient's foot. The assistant then changes her grasp to the foot and exerts gentle traction. Grasp the splint in the right hand and push it gently up the limb. As the ring reaches the thickest part of the thigh, do not continue to ram it higher in such a manner as to pinch the skin. With *the free hand*, draw the skin and subcutaneous fat from under the ring and finally press it firmly into the groin. *The bed splint ring must fit exactly*: one which is too small will cause sores from pressure, one which is too large will cause sores from friction. Adjust the slings with large safety pins, not

with clips. The slings should be at just sufficient tension to allow two-thirds of the limb to be seen above the splint. Lay three strips of bandage across the slings ready to secure the guarding splintage. Apply the posterior part of the guarding splintage, whether a metal or plaster splint. If a metal splint *is used, it must be padded with splint wool, and sufficient padding* must be placed under the head of the tibia to prevent hyperextension. The splint must not dig into the thigh or calf. Grasp the ankle above the malleoli and exert smooth gentle



Fig. 149
After applying the bed-splint and guarding splints, the whole is covered by a bandage.

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and counter traction has now l ... and must never be
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Daily nursing care

At first, it will be necessary to treat the area beneath the bed-splint ring four hourly Once the skin has become accustomed to the pressure once or twice daily should be sufficient. After the routine toilet wash the area beneath the ring and ring itself with a fairly dry well-soaped flannel. Then, with a good lather of soap, rub the area subjected to pressure with a circular movement until the lather disappears. Dry and powder lightly Ease the skin and soft tissues away from the ring so that a slightly different area is receiving pressure. The patient should be taught to do this regularly It is usually permissible to turn the patient on to his side to treat the posterior part of the ring If however the condition of the knee is very acute, the following procedure may be adopted. Two nurses are necessary A nurse stands on the side of the splinted limb and grasps the anterior part of the ring in one hand and the extension bows with the other steadying the splinted limb while the patient raises himself on his hands (or with the help of a pulley fixed over the bed) and the second nurse treats the posterior part of the ring the area beneath it and the patient's back. If the patient is very old or ill, a third assistant may be necessary who will stand at the other side of the bed and lift the patient's buttocks. It may become necessary to use grease if the patient is incontinent. An air-cushion or water pillow may be used for an old or helpless patient. The bed-splint ring should rest just inside the inner circle of an air-cushion.

Pressure-sores under the bed-splint ring These should not occur if the splint is a perfect fit and is kept immaculately clean, and if the skin is conscientiously treated from the first moment. The most usual sites for localised pressure-sores are the adductor tendon in the groin, the front of the hip-joint, and the ischial tuberosity The aim in treating these must always be to relieve the pressure which is the exciting cause and this can usually be effected by changing the position of the splinted limb If the sore is on the adductor tendon, abduct the limb, so that pressure in the groin is relieved. If on the front of the hip-joint tie the splint to the end of the bed, elevate the foot of the bed on a chair or block, and keep the patient lying so that the body weight falls away from the ring and pressure

is relieved. Pressure-sores on the ischial tuberosity may be treated by elevating the end of the splint on a 10 in. block so that the hip is flexed. Generalised skin irritation under the ring is best relieved by tying the splint to the elevated foot end of the bed, and keeping the patient recumbent.

Daily care of splintage. After the toilet and treatment of the ring area inspect the extensions and make sure that they are taut.

To tighten extensions. Two nurses are necessary and the patient must lie down. Remove the bandages. If plaster or metal lateral splints are used, remove them. If anterior and posterior shells are used, the anterior shell only should be removed. Nurse 1 grasps the limb above the malleoli and exerts smooth gentle traction whilst Nurse 2 secures the extension ties. Inspect the knee for swelling increased local heat or increasing deformity. Inspect the extensions. If extension sores form they may be treated as described in the previous chapter and extensions are reapplied in the same way the limb being supported throughout by an assistant. Replace the guarding splintage and if packing is used under the knee be certain that it is sufficient in amount to prevent hyperextension. See that the foot is warm of good colour and moving freely. Foot exercises are given by a physiotherapist. A back rest adds to the comfort of the older patient but it should be removed at night unless there are chest complications. Once the acute condition has subsided the patient should spend part of every day lying on his face with the foot over the end of the bed. This preserves the tone of the back muscles and gluteal muscles and prevents the contracture of the hip-flexors which may follow prolonged sitting.

To give a bed-pan to a patient in a bed-splint. If the patient is able to raise himself the bed pan is placed beneath him in the usual way. If however the condition is acute, or the patient is old or ill, one or two nurses may be necessary to raise the patient whilst a third places the bed-pan in position. Female patients should be encouraged to use a urinal. The patient is either turned on to his side or lifted as already described for cleansing purposes.

To X ray a patient in a bed splint

The patient lies comfortably on the X ray table An assistant steadies the limb by grasping the foot the extensions are untied, the guarding-splintage and finally the bed-splint itself is removed. This must be done with the utmost care *the knee must not be allowed to hyperextend nor must it be subjected to rotation strains* The antero-postero view is then obtained, by slipping the casette beneath the knee For the lateral view the patient is rolled gently towards the affected side the assistant turning the leg at the same time so that the body and limb turn as one unit the sound hip and knee is flexed on to the abdomen. The patient is then turned back in the same way splintage is reapplied and the patient made comfortable A visit to the X ray Department when splintage is removed, is a good opportunity to wash the area beneath the bed splint ring and treat it with soap and water The bed-splint ring can be thoroughly cleansed and rubbed with saddle soap at the same time

Later treatment

(1) *In children* Later treatment in childhood will depend upon whether the aim of treatment has been full free movement or sound ankylosis of the knee.

If the aim is full free movement, the surgeon may decide to discard all splintage and allow the patient to kick free in bed with the limb over a pillow If movement quickly returns with no adverse signs, exercises and weight bearing are gradually introduced. Any adverse sign such as pain, swelling, or rise of temperature must be promptly reported, and reapplication of splintage is ordered *Gradual mobilisation* may be ordered, commencing with quadriceps drill, then graduated exercises combined with fixation at night No forced movements are ever given. Finally all splintage is discarded and gradual weight-bearing introduced.

If the aim is sound ankylosis the treatment may be —

(a) Conservative consisting of retentive splintage or (b) operative, consisting of arthrodesis of the knee.

Indications for retentive splintage are as already described for tuberculosis of the hip-joint viz evidence that the primary lymphatic infection has been overcome with quiescence of the

local lesion. *Retentive splintage* usually consists of a weight relieving caliper combined with a guarding plaster cylinder *Measurements* for a caliper are as previously described (Chap V)

To apply a caliper and guarding plaster The boot must be tubed to receive the caliper Prepare a tray with gauze bandage, swabs, receiver a cleansing agent such as ether roll of elastoplast, the caliper and a screw-driver and materials for applying the plaster cylinder (Chap. IV) Two nurses are necessary and the patient must lie down. While an assistant steadies the limb by grasping the foot the bandage and guarding splintage is removed. Slide the bed-splint down the limb the nurse who is steadying the limb supporting the head of the tibia with one hand whilst maintaining traction with the other Remove the extensions and clean the limb with ether or spirit. Apply the gauze bandage from the webs of the toes to half way up the calf. This is to protect the skin. Then apply the elastoplast bandage, smoothly and evenly leaving no gaps. It must extend from the web of the toes to well up the calf beneath the guarding plaster to prevent swelling of the foot. Slide the caliper up the limb until the ring fits snugly into the groin. Apply the plaster cylinder over stockinette, moulding it well over the knee and supporting it in slight flexion. The caliper must be applied first, as no really well-fitting caliper will go on over a guarding plaster If for some reason the guarding plaster must be applied first, the caliper ring can be split and fastened with a strap and buckle. (Fig. 150) When the plaster has set, put on the boot and lace it Slip the prolongations into the tubed heel It may be necessary to shorten or lengthen the caliper by adjusting the screws. Fasten the sling behind the knee with safety pins, place the limb on a pillow and allow the cylinder to dry When it is dry fasten the knee shield. It is advisable to thread the straps of the knee



Fig 150.
Split caliper ring fastened with strap and buckle.

shield through slits cut in the back-sling One can then be sure that the knee is completely supported between the slings and knee-shield. To efficiently relieve weight the ring of the caliper must fit closely against the ischial tuberosity and the under surface of the heel must be just clear of the boot, so that the limb is suspended in the caliper and weight is borne through the ring and not directly through the knee joint Boots are to be preferred to shoes, especially in children, because if the caliper is truly weight relieving the heel tends to slip out of a shoe It may be necessary to place the heel tubing at an oblique angle to correct a persistent intoeing gait Later the guarding plaster may be discarded and a caliper only be worn. The application of a caliper only is carried out in the same way but special care must be taken to see that the sling behind the knee is tight enough to prevent hyper extension, as shown in Fig 3. The soft portion in the centre of the knee-shield should fit exactly over the patella and the lower straps must be tight enough to hold the knee firmly The upper straps should not be so tight as to press on the quadriceps.



Fig 151.
Weight relieving caliper and guarding plaster, applied in late treatment of tuberculosis of the knee.

Nursing care. The caliper must be worn continually unless otherwise ordered. The boot should be wrapped in old linen to protect the bed-clothes, and the ring area and the heel must be inspected for signs of pressure. If pressure sores occur under the ring-area, the patient is confined to bed and they are treated as for a bed-splint For pressure-sores on the heel, the boot is reversed, i.e. while an assistant steadies the limb, the

boot is removed and the sole covered by a piece of felt. The sole of the boot is then placed against the patient's foot and the caliper ends are replaced in the tubing. Fixation is thereby maintained, but pressure on the heel is removed. When the patient is accustomed to the caliper he is taught to stand and walk by a physiotherapist. The patient is taught to lift the affected leg straight forwards. He must not be allowed to swing it out sideways.

Operative treatment in childhood. This consists of excision of diseased synovia and bone with arthrodesis, and is undertaken when there has been such destruction of bone as to obviously preclude restoration of movement. The epiphyses are not involved so that growth in length of the limb is maintained. *Plaster fixation* is applied post-operatively most commonly in the form of a spica. When union is sound, a guarding plaster and caliper is worn, and one retained until growth of the limb has ceased.

Later treatment in adults may be (a) *Conservative* i.e. retentive splintage as described for children if for some reason (e.g. discharging sinuses) operation is contraindicated. (b) *Operative treatment* The indications for operation are as previously described for tuberculosis of the hip-joint. The operation consists of an excision and arthrodesis of the knee.

Preparation for operation. (1) *General preparation* as already described (i.e. investigation of urine blood, etc) (2) *Local preparation* A large area of skin (i.e. from the nipple line to the toes) is prepared by shaving painting with some antiseptic and sterile towelling. A plaster spica is usually applied post-operatively

Post-operative care. On return from the theatre in addition to the usual post-operative care, the plaster is dried as previously set out There is almost certain to be some oozing of blood through the plaster and this should be carefully observed. The extremities must be watched for signs of circulatory interference When the plaster is completely dry the surgeon may order the head of the bed to be elevated while the foot rests against a block or board at the foot of the bed. This is to press the excised surfaces closer together and hasten

union. After about three weeks, a window is cut over the knee and the sutures removed. The plaster spica is worn until union between the excised surfaces is well established when the patient is allowed up in a calliper and guarding plaster. The calliper is short (i.e. non weight relieving) and the ring should fit comfortably in the groin but not be pressed against the ischial tuberosity and the under surface of the heel is in contact with the boot. When union is complete the calliper is discarded and normal weight bearing resumed. Any discrepancy in the length of the limbs is compensated for by raising the boot.

CHAPTER XIII

TUBERCULOSIS OF OTHER BONES AND JOINTS

Tuberculosis of the sacro-iliac joint. Symptoms and signs. Conservative treatment. Later treatment. Operative treatment. Tuberculosis of the shoulder. Symptoms and signs. Treatment. Splintage. Plaster spica. Nursing care. Later treatment. Abduction splint. Nursing care. Operative treatment. Preparation for operation. Post-operative nursing care. Tuberculosis of the elbow joint. Symptoms and signs. Treatment. Splintage. Splintage in later stages. Nursing care. Operative treatment. Tuberculosis of the wrist joint. Symptoms and signs. Treatment. Immobilisation in a plaster cast. Nursing care. Later treatment. Splintage. Operative treatment. Tuberculosis of the ankle-joint. Symptoms and signs. Treatment. Immobilisation in a plaster cast. Later conservative treatment. Splintage. Double iron. Thomas patten-ended caliper. Operative treatment. Tuberculous of the carpal and tarsal bones. Tuberculous dactylitis.

TUBERCULOSIS OF THE SACRO-ILIAC JOINT

TUBERCULOSIS of the sacro-iliac joint is frequently combined with other tuberculous lesions. Young adults are most commonly affected. The disease may commence in the synovial membrane; the lower part of the sacro-iliac joint is most often attacked when the lesion becomes osseous.

Symptoms and signs. The general symptoms and signs are already described. The onset is insidious, and the presence of an abscess is frequently the first thing to be noticed. This may be seen over the sacro-iliac joint or it may track forwards under the ilio-psoas and point in the groin. There is pain, aggravated by sudden movements, and by strain, such as prolonged stooping. The gait is careful, and there is sometimes a list of the spine towards the unaffected side. There may be local tenderness on pressure over the affected joint.

X rays may show generalised osteoporosis and blurring of the joint outlines, *followed by* destructive changes, and, sometimes, the formation of sequestra.

Conservative treatment consists of immobilisation of the affected joint with general measures as already described.

Splintage (a) A straight frame with two groin-straps or a plaster pelvic-band. (b) A plaster bed with pelvic band. (c) A double abduction frame with groin-straps and skin-extensions. (d) A double plaster spica.

Nursing care is carried out on the lines already described for tuberculosis of the spine in Chap. X. A careful watch must be kept for abscess formation, which is the rule rather than the exception in sacro-iliac tuberculosis. Abscesses will be treated by aspiration.

Later treatment. *Retentive splintage* is ordered when the disease has reached quiescence. It consists of —(a) A plaster corset from the costal margins to the hip-joints, with groin straps incorporated, or a plaster spica incorporating the leg to the knee on the affected side (b) A sacro-iliac belt. This may be made of leather or celluloid, and may later be exchanged for one of the corset variety

Operative treatment consists of arthrodesis of the sacro-iliac joint Preparation and after-care is as for an operation on the spine.

TUBERCULOSIS OF THE SHOULDER JOINT

Tuberculosis of the shoulder is comparatively rare espec ially in children. There is commonly a pulmonary lesion on the same side. The lesion may be synovial or osseous it is sometimes of the atrophic type which is known as caries sicca

Symptoms and signs. The onset is insidious In an early case inflammation of the synovial membrane gives rise to pain, swelling local heat, tenderness, and limitation of movement. X rays may show osteoporosis without erosion. Later the arm is held to the side and there is muscle wasting particularly of the deltoid. The patient cannot raise his arm from his side and there is extreme limitation of movement X rays may then reveal gross osteoporosis with loss of joint outline and perhaps the presence of osseous foci.

Treatment. As the shoulder is not a weight-bearing joint, the surgeon may be satisfied with a fibrous ankylosis, which would be dangerous in joint subjected to such stresses and

strains as the hip or the knee In cases where gross destruction of bone has not occurred, a useful degree of movement, aided by the movements of the scapula on the chest wall, may be recovered.

(1) **Conservative treatment.** (a) *General treatment* is carried out in all cases. (b) *Local treatment* consists of immobilisation of the affected shoulder in the position of choice and is carried out in the early stages in both adults and children. (c) *Operative treatment* is carried out when neither a strong fibrous union nor the recovery of a useful range of movement is expected.

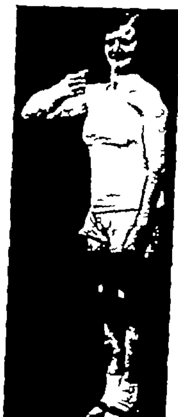


Fig 152.
Plaster shoulder spica used in the treatment of tuberculosis of the shoulder

Splintage. *In the early stage* a plaster spica is usually ordered *in the later stage* splintage may be (a) plaster spica with removable lid, or (b) an abduction splint.

A plaster spica is applied as described in Chap IV It includes the whole of the upper limb and must extend below the iliac crests. (Fig 152.) The wrist and hand may or may not be included. *The position of the shoulder* is decided by the surgeon and is governed by the clinical and X ray signs, and the patient's age and occupation. The most usual position for an adult is abduction 70 flexion 40 and enough external rotation to allow the mouth to be reached by the fingers when the elbow is flexed. *In all cases, the elbow* is flexed to the right angle the forearm is held in mid rotation and the wrist is dorsiflexed. Children are as a rule fixed in a greater degree of abduction than adults on account of the greater mobility of the scapula.

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Nursing care. Care of the plaster is described in Chap IV Unless the patient is ill he can sit in front of a fire until the spica is dry If however he is confined to bed, he will be most comfortable propped up with a back rest and plenty of pillows, except at night The arm must be supported and the extremities watched for circulatory interference. If the general condition is good, the patient is usually allowed up for at least part of the day though adequate rest must be ensured. A careful watch must be kept for scoliosis, particularly in a child, and exercises and games to improve the general health and musculature are usually ordered once the acute stage has passed.

Later treatment. (1) *Conservative treatment* The plaster spica is retained until the lesion is clinically and radiologically quiescent. The upper part of the spica may then be removed and graduated exercises commenced under the supervision of a physiotherapist No passive or forced movements are ever given.

An abduction splint may then be substituted for the plaster this may be of the Littler-Jones or aeroplane type. Measurements are given in Chap V

Application. The plaster is bivalved in readiness. Unless otherwise ordered, the splint is worn under the clothes. The patient sits on a stool and an assistant steadies the shoulder throughout. Remove the plaster and wash the areas of skin which have been covered. Powder the axilla, slide the splint underneath the arm, and fasten the pelvic band firmly Gently lower the arm on to the splint and adjust the slings so that it is supported in its entirety Fasten the webbing band over the unaffected shoulder Place a pad of splint wool under the head of the humerus and *be sure that it is supported at all times* Cover the limb with splint wool and bandage firmly See that the splint grips the pelvis firmly (Fig 47)

Daily nursing care. An abduction splint is reasonably comfortable to wear so long as the patient is up and about if he is confined to bed, the splinted limb must be supported on pillows.

Pressure sores. These most frequently occur at the point where the pelvi is held by the splint and under the posterior bar or the internal condyle of the humerus may be pressed

against the splint If a sore occurs under the pelvic-band, the whole of this can be covered with felt and lint or two pieces of felt can be secured to the bar on either side of a localised sore Sores under the posterior bar can be prevented by padding the whole bar with felt and lint or by inserting a strip of sorbo-rubber beneath it The internal epicondyle can be surrounded by a ring of felt The patient must be carefully watched for scoliosis and the shoulder must be inspected daily for swelling or deformity When the splint is removed for toilet purposes, the arm must be steadied by an assistant Later if movement is being recovered or ankylosis is progressing the patient may be allowed to wear the splint over his clothes, until it can be discarded altogether An axillary wedge is occasionally ordered (Fig 49)

(2) **Operative treatment** consists of an arthrodesis of the shoulder

Preparation for operation General preparation is as already outlined. The skin from the iliac crests to the supra sternal notch is shaved and prepared. In some cases, the body portion of the plaster cast which is to be worn post-operatively is applied beforehand, and completed after the operation. In any event the surgeon will hold the limb in the position he desires whilst the plaster is applied.

Post-operative care The patient is received into a warm bed in the usual way and the cast supported on pillows. Oozing of blood through the plaster must be carefully watched The fingers must be observed for circulatory changes, and when consciousness is recovered, inability to move the fingers must be reported at once. The plaster cast is worn until union is sound. Exercises to re-educate the scapular and shoulder muscles are gradually introduced, and eventually all splintage is discarded.

TUBERCULOSIS OF THE ELBOW JOINT

The elbow joint is more frequently attacked by tuberculosis than the shoulder or the wrist and more often in adults than in children. As in other joints, the lesion may be synovial in the first instance. An osseous focus is most commonly found in the ulna.

Symptoms and signs. The onset is insidious pain, aggravated by movement may first be confined to the joint itself and later may be referred to the forearm. There may be swelling local heat and tenderness, movements are limited by pain and muscle spasm and the joint eventually becomes stiff at a mid position. Muscle wasting is pronounced and as in the knee-joint exaggerates the appearance of the swelling *X rays* may show generalised osteoporosis of the joint, and a bony focus in one of its constituent bones.

Treatment. Early and efficient treatment usually preserves a useful joint especially in children. As in the shoulder a fibrous ankylosis is regarded as satisfactory

General treatment has already been described. *Local treatment* consists of immobilisation in the position of choice. *Splintage* in the early stage may be a plaster spica including the shoulder or an above-elbow plaster and sling In the later stage splintage may be a posterior plaster slab with collar and cuff a collar and cuff only an elbow-cage, or a block leather or celluloid splint.

(1) *Plaster spica* In very acute cases a plaster spica may be ordered and is applied as already described for the shoulder joint

(2) *Above-elbow plaster* A plaster is applied from the axilla to the web of the fingers. The position of the limb is decided by the surgeon As a rule the elbow is held in just above right-angled flexion the forearm in mid position and the wrist dorsiflexed. (Fig 12.) The plaster is supported in a sling or a collar and cuff but free movement of the shoulder and fingers must be maintained.

Splintage in later stages.

(1) *Plaster slab and collar and cuff* When the disease is quiescent a well-moulded posterior slab may be ordered and graduated exercises commenced

(2) *Collar and cuff* This may be ordered in the quiescent stage and is applied with the elbow held in the required amount of flexion. *Application* Thread two short lengths of bandage through two shoulder guards. Tie one round the neck and the other round the wrist Join them with a third piece of bandage. (Fig. 177)

against the splint. If a sore occurs under the pelvic-band the whole of this can be covered with felt and lint or two pieces of felt can be secured to the bar on either side of a localised sore. Sores under the posterior bar can be prevented by padding the whole bar with felt and lint or by inserting a strip of sorbo-rubber beneath it. The internal epicondyle can be surrounded by a ring of felt. The patient must be carefully watched for scoliosis and the shoulder must be inspected daily for swelling or deformity. When the splint is removed for toilet purposes, the arm must be steadied by an assistant. Later if movement is being recovered or ankylosis is progressing the patient may be allowed to wear the splint over his clothes, until it can be discarded altogether. An axillary wedge is occasionally ordered. (Fig. 49.)

(2) **Operative treatment** consists of an arthrodesis of the shoulder.

Preparation for operation. General preparation is as already outlined. The skin from the iliac crests to the suprasternal notch is shaved and prepared. In some cases, the body portion of the plaster cast which is to be worn post-operatively is applied beforehand, and completed after the operation. In any event the surgeon will hold the limb in the position he desires whilst the plaster is applied.

Post-operative care. The patient is received into a warm bed in the usual way and the cast supported on pillows. Oozing of blood through the plaster must be carefully watched. The fingers must be observed for circulatory changes, and when consciousness is recovered, inability to move the fingers must be reported at once. The plaster cast is worn until union is sound. Exercises to re-educate the scapular and shoulder muscles are gradually introduced, and eventually all splintage is discarded.

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Symptoms and signs. The *onset* is insidious pain, aggravated by movement may first be confined to the joint itself and later may be referred to the forearm. There may be swelling local heat and tenderness, movements are limited by pain and muscle spasm and the joint eventually becomes stiff at a mid-position. Muscle wasting is pronounced and as in the knee joint exaggerates the appearance of the swelling *X rays* may show generalised osteoporosis of the joint and a bony focus in one of its constituent bones.

Treatment. Early and efficient treatment usually preserves a useful joint especially in children. As in the shoulder a fibrous ankylosis is regarded as satisfactory

General treatment has already been described. *Local treatment* consists of immobilisation in the position of choice. *Splintage* in the early stage may be a plaster spica including the shoulder or an above-elbow plaster and sling In the later stage splintage may be a posterior plaster slab with collar and cuff, a collar and cuff only an elbow-cage, or a block leather or celluloid splint.

(1) *Plaster spica* In very acute cases a plaster spica may be ordered and is applied as already described for the shoulder joint

(2) *Above-elbow plaster* A plaster is applied from the axilla to the web of the fingers. The position of the limb is decided by the surgeon As a rule the elbow is held in just above right-angled flexion, the forearm in mid position and the wrist dorsiflexed. (Fig 12.) The plaster is supported in a sling or a collar and cuff but free movement of the shoulder and fingers *must* be maintained.

Splintage in later stages.

(1) *Plaster slab and collar and cuff* When the disease is quiescent a well moulded posterior slab may be ordered and graduated exercises commenced.

(2) *Collar and cuff* This may be ordered in the quiescent stage and is applied with the elbow held in the required amount of flexion *Application* Thread two short lengths of bandage through two shoulder guards. Tie one round the neck and the other round the wrist Join them with a third piece of bandage. (Fig. 177)

(3) *Elbow-cage* (Fig 50)

(4) *Block-leather or celluloid splint* Either of these may be ordered in the quiescent stage to protect the joint A cast must be taken.

Daily care. Whatever form of splintage is adopted, it is the duty of the nurse to inspect it daily and to see that all other joints are not becoming stiff The patient is usually allowed up once the acute stage is over but adequate rest must be insisted upon.

Operative treatment usually consists of excision of the joint with or without subsequent arthrodesis in the position of choice followed by plaster fixation until union is sound

TUBERCULOSIS OF THE WRIST JOINT

Tuberculosis of the wrist is relatively uncommon especially in childhood. The synovial membrane may be first attacked, or an osseous lesion may be found in one of the constituent bones of the wrist joint usually in the lower end of the radius.

Symptoms and signs. There may be pain swelling, local heat and tenderness, limitation of movement and deformity The wrist is usually held in palmar flexion Abscesses are superficial and quickly break down and form sinuses. X rays may show generalised osteoporosis or the presence of an osseous focus.

Treatment. (1) *General treatment* as for other tuberculous lesions. (2) *Local treatment* consists of immobilisation in plaster The plaster cast extends from the knuckles to just below the elbow or an above-elbow plaster may be ordered for more stringent fixation. Particular attention must be paid to the position of the wrist About 30 dorsiflexion is usually ordered, and if the thumb is included it must be held in opposition. Unless otherwise ordered, the plaster extends only to the transverse creases in the palm, as shown in Fig. 11 If the metacarpo-phalangeal joints are included, they must be held in slight flexion and the normal palmar arch maintained.

Nursing care. The plaster is inspected daily for cracks or softening as described in Chap. IV A careful watch is kept

for signs of pressure-sores. Full movements of the shoulder and fingers *must* be preserved. The patient is allowed up once the acute stage is over and general exercises are usually ordered though it should be noted that when ambulant these patients often tend to do too much adequate rest must be ensured.

Later treatment. Plaster fixation is continued until the disease is quiescent (usually 1 2 years)

Retentive splintage may be ordered, consisting of a leather or celluloid moulded splint made on a cast of the wrist (Fig 53.) A watch must be kept for pressure-sores on such bony prominences as the ulnar styloid.

Operative treatment is undertaken when the lesion is quiescent and usually consists of an arthrodesis. The wrist is immobilised in plaster in the position of choice until union is complete.

TUBERCULOSIS OF THE ANKLE JOINT

The clinical picture of tuberculosis of the ankle joint is similar to that of the wrist, and as in other joints, the lesion may be synovial or osseous. Abscess formation is common.

Treatment. (1) *General treatment* is standard. (2) *Local treatment* consists of immobilisation in a well moulded below knee plaster cast occasionally an above-knee cast is necessary If multiple sinuses are present, a crab-splint may be ordered. (Fig. 43) This is applied in the same way as a club-foot shoe. Recumbency is essential in the acute stage weight bearing in plaster is gradually introduced when the disease is approaching quiescence or crutches may be ordered.

Daily care is as for any tuberculous joint immobilised in plaster

Later conservative treatment consists of retentive splintage which may be —(a) Double iron, either fixed in the boot or held by contrary stops, and a plaster shell for night wear (b) Thomas patten-ended caliper and a plaster shell for night wear

Measurements for these splints will be found in Chap V

(a) **Double iron.** The heel of the boot is either fitted with square sockets which exactly fit the iron (Fig 39) or tubed and fitted with contrary stops.

Application. The plaster is bivalved in readiness, and the skin cleaned. An elastoplast or crepe bandage may be applied for the first few days to control swelling. Unfasten the strap and apply the iron, put on the boot and fit the lower ends into the tubing.

A T-strap, placed on the opposite side to the deformity may be ordered to control incipient varus or valgus deformity of the foot. The patient is then taught correct walking by a physiotherapist and exercises are given for the general musculature.

Daily care. See that the iron fits closely just below the knee. A tendency to pressure-sores can be controlled by padding the surface of the ring with felt. The boot must be kept in good repair and if contrary stops are used, they must be constantly inspected as they tend to yield to the pressure of the iron and allow a little movement. See that the ring of the iron does not cause pressure on the lateral popliteal nerve and produce a drop-foot.

(b) **Thomas' patten-ended caliper** (Fig. 34.) A patten (usually 3 ins. at the heel sloping to 2 ins. at the sole) is applied to the boot of the unaffected side. It should compensate exactly for the length of the caliper. Apply as for a walking caliper. See that the knee is properly supported and that the affected limb hangs free in the splint. Fasten the webbing band on the opposite shoulder. The patient is taught to walk by a physiotherapist.

Daily care. Care of the skin under the ring as for an ordinary caliper. Watch the patient closely for signs of scoliosis, as this quickly develops due to the pull of the webbing band on the shoulder.

Operative treatment may consist of an excision and arthrodesis of the joint, followed by plaster fixation until union is sound. In severe cases, amputation of the limb may be necessary to save the patient's life.

Tuberculosis of the carpal or tarsal bones

Treatment consists of general measures combined with immobilisation of the hand or foot in a plaster cast, care being taken to maintain the normal palmar or plantar arches and the

function of the fingers or toes. Tuberculosis of the tarsal bones in adults usually indicates a severe infection and amputation of the foot may be necessary.

Tuberculosis dactylitis

This is confined to young children and affects the metacarpals, metatarsals, or phalanges of the fingers or toes. The fingers or toes become stiff, swollen, and painful, and abscesses quickly break down and form sinuses.

Treatment. (1) *General treatment* as for other tuberculous lesions. (2) *Local treatment* is conservative or operative.

(a) *Conservative treatment.* If the foot is affected, plaster fixation in recumbency is usually ordered. In the case of the metacarpals or phalanges of the fingers, fixation is not as a rule ordered because of the resulting stiffness and impairment of use of the hand, though a light plaster splint may be ordered for a short time if the condition is very acute and the patient ill. The prognosis is good with efficient and prolonged general treatment.

(b) *Operative treatment* consists of excision of a local focus, or amputation of an affected finger or toe.

Application. The plaster is bivalved in readiness, and the skin cleaned. An elastoplast or crepe bandage may be applied for the first few days to control swelling. Unfasten the strap and apply the iron, put on the boot and fit the lower ends into the tubing.

A T-strap placed on the opposite side to the deformity may be ordered to control incipient varus or valgus deformity of the foot. The patient is then taught correct walking by a physiotherapist and exercises are given for the general musculature.

Daily care. See that the iron fits closely just below the knee. A tendency to pressure-sores can be controlled by padding the surface of the ring with felt. The boot must be kept in good repair and if contrary stops are used, they must be constantly inspected as they tend to yield to the pressure of the iron and allow a little movement. See that the ring of the iron does not cause pressure on the lateral popliteal nerve and produce a drop-foot.

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Operative treatment may consist of an excision and arthrodesis of the joint, followed by plaster fixation until union is sound. In severe cases, amputation of the limb may be necessary to save the patient's life.

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Tuberculosis dactylitis

This is confined to young children and affects the metacarpals, metatarsals, or phalanges of the fingers or toes. The fingers or toes become stiff, swollen and painful, and abscesses quickly break down and form sinuses.

Treatment. (1) *General treatment* as for other tuberculosis lesions. (2) *Local treatment* is conservative or operative.

(a) *Conservative treatment.* If the foot is affected, plaster fixation in recumbency is usually ordered. In the case of the metacarpals or phalanges of the fingers, fixation is not as a rule ordered because of the resulting stiffness and impairment of use of the hand, though a light plaster splint may be ordered for a short time if the condition is very acute and the patient ill. The prognosis is good with efficient and prolonged general treatment.

(b) *Operative treatment* consists of excision of a local focus, or amputation of an affected finger or toe.

CHAPTER XV

PYOGENIC ARTHRITIS

(Septic arthritis, infective arthritis)

Mode of infection. Pathological changes. Symptoms and signs. Treatment. Splintage. Later treatment. Some other affections of joints. Toxic arthritis of childhood. Syphilis of joints. Gonococcal arthritis. Haemophilia.

PYOGENIC arthritis is due to the infection of a joint cavity by pyogenic organisms. The staphylococcus is most frequently found especially in children; other organisms are the streptococcus, the pneumococcus, the gonococcus, or more rarely the bacillus typhosus. The organism may be blood-borne and gain entrance as in acute osteomyelitis, or it may enter the joint from a wound or compound fracture. Pyogenic arthritis may occur as a complication of acute infections such as pneumonia.

The reaction of the joint depends on the virulence of the infection and the resistance of the individual. In all cases, there is distension of the joint by an exudation of fluid; in early cases this may be serous and due to a simple synovitis. Later the joint becomes filled with sero-fibrinous exudate and in severe cases frank pus may be found. If the disease is unchecked, destruction of joint surfaces will occur and sometimes, pathological subluxation. In early cases, good function is often preserved, but gross destruction generally leads to ankylosis of the joint.

Symptoms and signs. There is pain, swelling, local heat and tenderness. Movements of the joint are impossible because of pain and muscle spasm, and the joint is fixed in flexion. The systemic upset is great and the clinical picture is similar to that of acute osteomyelitis (Chap. XIV) which indeed is often an accompanying feature. There is pyrexia (100–103°), and the patient is of toxic appearance. Dehydration and anaemia rapidly occur.

Treatment proceeds on the lines already described for acute osteomyelitis—rest, both general and local, combined with chemotherapy and the maintenance of fluid balance.

Aspiration of the joint is sometimes performed and in cases where frank pus is present this may be followed by drainage, when pus is evacuated and the joint washed out.

Splintage is applied according to the joint involved and should permit of free inspection. *Traction* is usually ordered. An affected hip requires fixation on an abduction frame with skin-extensions. A Thomas bed splint with skin-extensions and lateral guarding splints is used for the knee.

Later treatment consists of free mobilisation in bed, with graduated exercises and eventual weight-bearing. Gross destruction rendering ankylosis certain may necessitate protected weight bearing in splintage, e.g. a plaster spica for the hip or a caliper for the knee.

SOME OTHER AFFECTIONS OF JOINTS

(1) **Transient or toxic arthritis of childhood.** It is thought that this may be secondary to infection of the tonsils. The hip or the knee is commonly affected, and the symptoms and signs may simulate a tuberculous or other infective arthritis in its early stages.

Treatment is instituted as if this is in fact the case. If after two to three months' treatment the condition has subsided and X-rays show no change, the surgeon may advise gradual mobilisation in bed. This is followed by gradual weight bearing, and if there is no return of symptoms, the child is allowed home. On discharge, the parents are asked to communicate with the hospital if there is a return of the symptoms, and *supervision is continued until it is certain that the condition has in fact subsided.*

(2) **Syphilis of joints** is usually symmetrical, e.g. affecting both knees. It is accompanied by other signs of the disease, and the Wassermann reaction is positive.

Clutton's joint is the name given to the painless effusion in the knees of the congenital syphilitic.

Charcot's joint is the name given to the swollen, deformed and disorganised joints which may accompany tabes dorsalis or general paralysis of the insane.

Treatment consists of medical measures for the systemic disease. Splintage to prevent deformity or to relieve weight may be ordered, e.g. a caliper or knee-cage.

Physiotherapy to strengthen the musculature may be advised. In rare cases, arthrodesis of the joint may be performed.

(3) **Gonococcal arthritis** may be acute affecting one large joint, or many joints may be affected, when the condition resembles rheumatoid arthritis. There is pain stiffness and swelling of the joint eventually the articular cartilage is dissolved and ankylosis occurs.



A. Fig 153. B.
A. Haemarthrosis of right knee with flexion contracture.
B. Same case wearing caliper after correction by traction on a Thomas bed splint.

Treatment consists of medical measures for the systemic disease. Splintage and physiotherapy may be ordered.

(4) **Haemophilia** is a hereditary sex linked disease in which the clotting of blood is retarded. Extravasation of blood into a joint may follow a trivial injury. The knee is most commonly affected, and becomes swollen hot and painful. Flexion contracture may occur (Fig 153A.)

Treatment consists of rest and splintage to the affected joint with correction of deformity where necessary. Physiotherapy is begun when haemorrhage has ceased, and splintage such as a caliper may be ordered to protect the joint. (Fig 153B.)

Symptoms and signs. There is gnawing pain in the affected joint aggravated by changes of weather Stiffness is worse after rest and tends to improve with activity There may be creaking and grating sounds in the joint and the patient feels that the bones are being ground together In the later stages, deformity may be present.

X rays show progressive diminution of the joint space with osteophytic lipping and sclerosis.

The aims of treatment are —the relief of pain, the prevention or correction of deformity and the preservation or restoration of the function of the joint. Treatment is determined by the following factors —(1) The stage of the disease, i e. the amount of pain and disability suffered. (2) The age of the patient (3) The physical and mental condition of the patient.

Outline of treatment. *General treatment* consists of attention to the general health with removal of any predisposing cause, for example, the reduction of weight Salicylates may be ordered for the relief of pain. The patient is advised to adopt a healthy regime of life avoiding excesses in eating and drinking and though regular outdoor exercise is encouraged, fatigue should be avoided.

Local treatment is aimed at preserving a useful range of painless movement in the joint. The patient is examined as a whole so that predisposing factors can be eliminated. For example a patient suffering from osteo-arthritis of the spine may be found to have shortening of one leg Compensation for this by raising the footwear may relieve the pain in the back.

Supports may be ordered to protect the joint and to prevent deformity by limiting movement or relieving weight. For example a back support or a belt may be ordered in the case of the spine and a caliper or knee-cage in the case of the knee.

Physiotherapy *Active exercises* are practised intensively to re-educate all muscle groups controlling the affected joint Exercises may be non weight bearing at first and gradually progress to full movements within the limits of pain In addition to special exercises, general postural training and re-education in walking is essential Passive and forced movements are not given heat in all its forms is useful in relieving pain.

Lactic acid injections are sometimes ordered, followed by active exercises.

Manipulations In selected cases, gentle manipulation under anaesthesia may be advised. It is followed by active exercises, so that any movement gained is controlled by the musculature.

Operative treatment. This may be advised if the general health and mentality is good, and may be —(1) *osteotomy* to correct deformity; (2) *arthrodesis*, to provide a stiff but stable and painless joint (3) *arthroplasty* to provide a movable and painless joint.

Osteo-arthritis of the spine

This condition is characterised by pain in the back, accompanied by gradually increasing stiffness and kyphotic deformity

Treatment Early cases require general measures as already described. Physiotherapy is generally advised, with special emphasis on back raising exercises.

Supports A plaster jacket may be applied as a temporary measure and if pain is thereby relieved, it may be replaced by a strong corset or body belt a belt of the Goldthwaite type similar to that shown in Fig. 119 a Jones spinal support, or some other type of spinal brace.

Manipulation under anaesthesia may be advised, followed by active exercises.

Operative treatment A spinal fusion may be performed if the disease is localised, e.g following an old wedge fracture of a vertebra.

Osteo-arthritis of the hip-joint

This produces greater disability than osteo-arthritis of any other joint There is constant nagging pain, and stiffness is a marked feature though the flexion-extension range of movement i often preserved. Eventually there may be flexion-adduction deformity and apparent shortening of the limb.

Treatment. Early cases require treatment by general measures and physiotherapy as already described. In later cases, treatment may be conservative or operative.

Symptoms and signs. *There is gnawing pain in the* affected joint aggravated by changes of weather Stiffness is worse after rest and tends to improve with activity There may be creaking and grating sounds in the joint, and the patient feels that the bones are being ground together In the later stages, deformity may be present.

X rays show progressive diminution of the joint space with osteophytic lipping and sclerosis.

The aims of treatment are —the relief of pain, the prevention or correction of deformity and the preservation or restoration of the function of the joint. Treatment is determined by the following factors —(1) The stage of the disease, i.e the amount of pain and disability suffered. (2) The age of the patient (3) The physical and mental condition of the patient.

Outline of treatment. *General treatment* consists of attention to the general health with removal of any predisposing cause, for example, the reduction of weight Salicylates may be ordered for the relief of pain. The patient is advised to adopt a healthy regime of life avoiding excesses in eating and *drinking, and though regular outdoor exercise* is encouraged, fatigue should be avoided.

Local treatment is aimed at preserving a useful range of painless movement in the joint. The patient is examined as a whole so that predisposing factors can be eliminated. For example a patient suffering from osteo-arthritis of the spine may be found to have shortening of one leg Compensation for this by raising the footwear may relieve the pain in the back.

Supports may be ordered to protect the joint and to prevent deformity by limiting movement or relieving weight. For example a back support or a belt may be ordered in the case of the spine, and a calliper or knee-cage in the case of the knee.

Physiotherapy *Active exercises* are practised intensively to re-educate all muscle groups controlling the affected joint. Exercises may be non-weight bearing at first and gradually progress to full movements within the limits of pain. In addition to special exercises, general postural training and re-education in walking is essential. Passive and forced movements are not given heat in all its forms is useful in relieving pain.

Lactic acid injections are sometimes ordered, followed by active exercises.

Manipulations In selected cases, gentle manipulation under anaesthesia may be advised. It is followed by active exercises, so that any movement gained is controlled by the musculature.

Operative treatment. This may be advised if the general health and mentality is good, and may be —(1) *osteotomy* to correct deformity (2) *arthrodesis*, to provide a stiff but stable and painless joint (3) *arthroplasty* to provide a movable and painless joint.

Osteo-arthritis of the spine

This condition is characterised by pain in the back, accompanied by gradually increasing stiffness and kyphotic deformity

Treatment Early cases require general measures as already described. Physiotherapy is generally advised with special emphasis on back raising exercises.

Supports. A plaster jacket may be applied as a temporary measure and if pain is thereby relieved, it may be replaced by a strong corset or body-belt a belt of the Goldthwaite type similar to that shown in Fig 119 a Jones spinal support, or some other type of spinal brace.

Manipulation under anaesthesia may be advised, followed by active exercises.

Operative treatment A spinal fusion may be performed if the disease is localised, e.g following an old wedge fracture of a vertebra.

Osteo-arthritis of the hip-joint

This produces greater disability than osteo-arthritis of any other joint There is constant nagging pain, and stiffness is a marked feature though the flexion-extension range of movement is often preserved. Eventually there may be flexion adduction deformity and apparent shortening of the limb.

Treatment. Early cases require treatment by general measures and physiotherapy as already described. In later cases, treatment may be conservative or operative

Conservative treatment usually consists of continued physiotherapy combined with some form of support for the hip which may take the form of a flannel or elastoplast spica, a plaster spica a block leather spica, or strong corset with leg piece. Raising to the shoe on the affected side may be required to compensate for apparent shortening

Manipulation under anaesthesia may be advised, and is followed by active exercises.

Operative treatment. Various operations may be performed. Those directed towards the correction of deformity include —(a) *Tenotomy of adductors* (b) *obturator neurectomy* which cuts the nerve-supply to the hip-joint; (c) *osteotomy*

Arthrodesis of the hip-joint may be performed in those cases in which only one hip is affected. It is followed by immobilisation in a double plaster spica.

Arthroplasty of the hip is aimed at providing a movable but painless hip-joint It may be one of two operations —(a) *Excision of the femoral head and neck, followed by traction* and early movements. Weight bearing in a caliper is gradually introduced in about six weeks. (b) Cup-arthroplasty

Cup-arthroplasty In this operation a vitallium cup is placed in the acetabulum to contain the femoral head. Movement of the cup in the acetabulum and of the femoral head in the cup provides a varying degree of movement at the hip-joint.

After treatment. Various regimes may be adopted. (1) Balanced skin traction with about 5 lbs. weight on a suspended Hodgen's splint with Pearson knee flexion attachment. Strict attention to the posture of the patient in bed is essential. External rotation or adduction of the limb may result in dislocation of the femoral head. A sandbag is placed beneath the great trochanter to maintain internal rotation of the limb. Active quadriceps drill and hip abduction exercises are commenced at once. Alternate sitting up and lying flat is practised at intervals throughout the day In about four weeks, the traction is removed and plaster shells holding the limb in internal rotation and fitted with rollers are applied. Roller skating abduction-adduction exercises on sloping boards are then commenced.

(2) In some cases, post-operative fixation consists of a plaster splca holding the limb in abduction and internal rotation. This may be retained for about three weeks, and is followed by roller-skating exercises as already described.

(3) Broomstick plasters are sometimes used (*Fig 161*) These are applied in abduction and internal rotation, and are followed by exercises as already described

Physiotherapy Supervised exercises and intensive re-education is essential in all cases and are continued over a very long period.

Osteo-arthritis of the knee-joint

This is frequently seen in obese women especially at the menopause In early cases, treatment consists of general measures as before with special regard to the treatment of predisposing causes, such as obesity or flat feet Physiotherapy consists of the application of local heat and graduated exercises for the knee-joint. *Quadriceps drill* must be practised intensively Occasionally a supporting bandage is ordered.

In later cases, conservative treatment may consist of some *form of splintage such as a plaster cylinder a knee-cage or a* caliper Physiotherapy is continued. Injections of lactic acid or manipulation under anaesthesia may be advised followed by active exercises.

Operative treatment may be —(1) Removal of loose bodies. (2) Synovectomy (3) Arthrodesis of the knee joint

CHAPTER XVII

RHEUMATOID ARTHRITIS

Pathological changes. Symptoms and signs. Aims of treatment. General treatment. Local treatment. Correction of flexion deformity of the hip-joint. Dame Agnes Hunt plaster. Correction of flexion deformity of the knee. Foot deformities.

RHEUMATOID arthritis is a painful and crippling condition of joints. It is commonest in early adult life though it may appear at any age. In children, it is called Still's disease. It is usually poly articular affecting many joints; more rarely it is mono-articular affecting one large joint. The cause is not clearly understood. A hereditary predisposition may be present.

Pathological changes. There is cell infiltration of the synovial membrane and a layer of granulation tissue called a pannus spreads over the articular cartilage and destroys it. The bones become decalcified, the joint capsule thickened and there is a strong tendency to subluxation or dislocation. Unlike osteo-arthritis, ankylosis is common.

Symptoms and signs. As a rule the general health is not robust. The onset may be acute or subacute with progressive stiffness and lameness, pain, swelling, thickening, local heat and effusion into the joints. Pain and stiffness gradually increases, and joint after joint may become affected, a new joint flaring up as another settles down. Deformities may eventually become fixed by adhesions and muscle spasm, and later by bony fusion, with distortion or even dislocation of the joints.

The deformities most commonly seen are :—*Upper limbs*—flexion of the elbow, palmar flexion of the wrist with ulnar deviation of the hand. *Lower limbs*—flexion and adduction of hip, flexion of the knees, and plantar flexion of the ankles. (Fig. 154A.)

The extremities may be cold and blue, and there is localised sweating; the skin becomes thick and sallow and the nails

thickened and striated. There is generalised muscle atrophy with lassitude and inertia and the anxious expression denotes the distress of body and mind. X rays show decalcification of the bones of an affected joint with progressive loss of joint space and eventually ankylosis.

Aims of treatment. To relieve pain, to prevent or correct deformity and to retain useful movement where possible.



A.

B.

Fig. 134.

A. Rheumatoid arthritis affecting almost every joint. Note the deformities of hips, knees and ankles. B. The same patient after treatment.

(1) *General treatment* is carried out on the advice of a physician. Rest is essential in the acute stage; sedatives are given for the relief of pain; dietary measures, tonics, gold salts and other substances may be ordered. Constipation must be avoided, fluids are given freely and warmth is an important factor. Septic foci are investigated and treated.

(2) *Local treatment.* In the acute stage splintage is applied to rest a painful joint and to prevent or correct deformity

Particular care must be taken to avoid subluxation of a joint, and the limbs must be handled gently but firmly During the period of splintage non weight bearing exercises, with static muscular contractions, are practised within the limits of pain. *The possibility of ankylosis must be borne in mind and a nice* balance maintained between rest and activity The general health of the patient and the amount of pain and swelling will be the guide to the progress of the treatment.

Upper limbs. A light plaster or metal cock up splint to the wrist may be ordered. The wrist is held in about 30 dorsi flexion if the fingers are splinted they are held in slight flexion the palmar arch must be maintained and subluxation of the metacarpo-phalangeal joints prevented As the acute condition subsides, the splintage is gradually discarded, and active movements are introduced. The patient must be con stantly encouraged to maintain such movement as he has by using the hands as much as possible. The occupational thera pist will encourage activities such as knitting basket making or leather work, but the nurse must constantly encourage her *patient to feed himself to write and knit and to play games* which involve the use of the hands.

Lower limbs. Flexion deformity of the hips and knees constitutes a severe disability Conservative measures to correct these deformities may be ordered if ankylosis has not occurred, otherwise operative procedures are employed, when pain and swelling have been absent for about six months and the general *health is good. The operation may be an osteotomy or an arth* roplasty of the hip or an excision of the knee

Correction of flexion deformity of the hip-joint. (1) In early cases, *fixation on a double-abduction frame with skin extensions* may be ordered for a short time but the possibility of early ankylosis must be borne in mind If ordered frame fixation is applied and nursed as described in Chap. XI *Movements are commenced as soon as possible*

(2) *Dame Agnes Hunt plaster* This may be ordered in late cases, where deformity is already established.

Application A single plaster spica is applied with the sound hip and knee flexed at the right angle and the lumbar

lordosis obliterated. The foot may or may not be included. The opposite limb is then fixed in a Thomas' bed-splint with skin extensions in the usual way. At first the splint is supported on pillows in the flexed position, then gradually lowered until it rests on the bed. The flexion-contracture of the splinted limb is thus gradually reduced (Fig. 1.5.)

In cases where both hips are affected, correction of one will be followed by application of a single spica. The opposite limb is then fixed in a Thomas' bed-splint which is gradually lowered in the same way.

Correction of flexion deformity of the knee. (1) *Wedged plaster.* The knee is covered with a thick layer of felt and wool



Fig. 1.5.
Dame Agnes Hunt plaster for correction of flexion contracture of the hip. (See text.)

and the limb is immobilised in a plaster cast. When it has thoroughly set, the back of the plaster is split three-quarters of the way round at the line of the knee-joint. The split is opened, pieces of cork are wedged in and gradually increased in size until the desired position has been reached.

(2) *Thomas' bed-splint* which is either bent at the knee or combined with a Pearson flexion attachment.

(a) The Thomas' bed-splint is bent at the level of the knee-joint to the same degree of flexion as the knee. It is applied in the usual way and the extensions tied. The splint is then gradually straightened a few degrees every second or third day until the extended position is reached. *The knee must not be allowed to become subluxated: adequate support for the head of the tibia must be ensured.*

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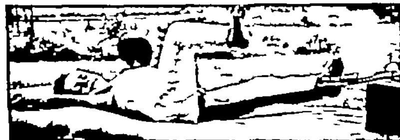


Fig. 155.
Dam Agnes Hunt plaster for correction of flexion contracture of the hip. (See text.)

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(a) The Thomas' bed-splint is bent at the level of the knee-joint to the same degree of flexion as the knee. It is applied in the usual way and the extensions tied. The splint is then gradually straightened a few degrees every second or third day until the extended position is reached. *The knee must not be allowed to become subluxated*: adequate support for the head of the tibia must be ensured.

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Application. A single plaster spica is applied with the sound hip and knee flexed at the right angle and the *lumbar*

CHAPTER XVIII

SPONDYLITIS ANKYLOPOETICA

(Ankylosing spondylitis, Marie-Strumpell's disease)

Symptoms and signs. Treatment. Restoration of alignment of the spine by means of a plaster bed. Physiotherapy. Ambulatory splintage. Operative treatment.

THIS condition is characterised by a gradual ankylosis of the spine by deposits of bone in the ligaments. It occurs most commonly in males between the ages of twenty and thirty five. The individual is typically thin, sallow, dark haired, and of a pleasant disposition. The cause is obscure.



Fig 156.
Typical deformity of the spine in ankylosing spondylitis. In this case the hip-joints are also affected.

Symptoms and signs. There is pain in the back, accompanied by gradually increasing stiffness and deformity. The deformity is characteristic and consists of an obliteration of all the normal spinal curves until the spine becomes C-shaped when viewed from the side (Fig. 156). The head is carried forwards, the shoulders are rounded, and the chest sunken. The inter-costal articulations become involved, so that the chest expansion is markedly limited, and breathing becomes abdominal in character. The hip-joints may be affected and flexion deformity occurs. Other joints such as the knees and ankles may become involved.

X ray changes. The earliest X ray signs are those of obliteration of the sacro-iliac joints. In late cases the lumbar spine shows a type of fusion between the vertebral bodies, known as bambooing.

(b) The Thomas splint is applied in the usual way with Pearson flexion knee-piece attached at the level of the knee-joint The skin extensions are tied to the flexion piece and this is gradually straightened until the extended position is reached.

Foot deformities are usually corrected by manipulation and plaster fixation Operative treatment consists of stabilisation of the ankle or foot

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X-ray changes. The earliest X-ray signs are those of obliteration of the sacro-iliac joints. In late cases the lumbar spine shows a type of fusion between the vertebral bodies, known as "bambooing."

Treatment. The aims of treatment are as follows:—relieve pain, to arrest the progress of the disease to prev deformity of the spine and to maintain other joints in the b functional position should ankylosis occur

General treatment Recumbency is essential in the act stage and measures to improve the general health may advised by a physician.

Local treatment consists of —

(1) Splintage to prevent or to correct deformity

(2) Physiotherapy to improve the musculature and preserve movement where possible

(3) *Deep X ray therapy*

Splintage. A plaster bed is usually ordered though frame may be used

To restore the alignment of the spine by means of a plast bed The plaster bed is made in the usual way while the patie lies in as good a position as can be obtained. A headpiece usually included. When it is almost completed, two or thr *pieces of strip-aluminium are incorporated down the length* the bed. It is then mounted on blocks in the usual way exce that the block beneath the shoulders is so constructed as enable it to be gradually lowered. The patient is placed in t bed, and nursed as already described in Chap. X. A day or is allowed for the patient to become reconciled to fixation an hyperextension is commenced.

Method The patient is lifted out of the bed on to pillow The bed is then split at the site of maximal deformity It ca be hyperextended the desired amount whilst its original form still maintained by the aluminium strips. The block beneath th kyphos is lowered, and the patient is replaced on the bed. Su cessive beds can be made until full correction is obtained. Du ing the correction the possibility of complete ankylosis mu be borne in mind, and the aim should be *restoration of the no mal spinal curves* It may be necessary to split the bed in tw or more places (e g in both the lumbar and dorsal regions) i order to produce normal alignment of the spine (Fig 1 7 Traction may be ordered if the hips are becoming involved.

usually removed from the bed daily for exercises for the spinal muscles, so that any correction gained can be maintained (2) *Breathing exercises.* These are of vital importance in order to retain as much respiratory excursion as possible It is encouraging to the patient to measure the chest-expansion. If none can be gained, at least none should be lost (3) *General exercises.* These are aimed at retaining as much movement as possible and improving the general musculature. When weight-bearing is resumed, postural training and re-education in walking is introduced.



Fig 157
Right plaster bed used in correction of spinal deformities due to ankylosing spondylitis. In this case the bed is split in the cervical, dorsal and lumbar regions.

Ambulatory splintage is worn to prevent relapse and further deformity It may be —(1) A plaster jacket. (2) A Jones spinal support (3) Any other type of spinal support.

N.B The support must be closely moulded so as to preserve the normal curves of the spine

Operative treatment is most commonly employed in the treatment of ankylosed hip-joints, when either a cup-arthroplasty or an excision of femoral head and neck is undertaken. Osteotomy of the spine may be performed in cases in which ankylosis with deformity has taken place

CHAPTER XIX

LUMBAGO AND SCIATICA

Definition. Causes. Sacro-iliac strain. Treatment. Lumbo-sacral strain. Treatment. Sciatic scoliosis. Rupture of an intervertebral disc. Clinical features. Treatment. *Operative treatment.*

LUMBAGO is the name given to a pain in the lower back. Sciatica is the name given to a pain referred along the course of the sciatic nerve, down the back of the leg and, sometimes, into the foot.

Pain in the lower back is a very common affliction, and may be due to a multitude of conditions. Many of these such as visceroptosis or gynaecological upsets in women, are outside the scope of the orthopaedic surgeon. Low back pain may be due to strain of the sacro-iliac or lumbo-sacral joints, or of the muscles or ligaments surrounding them. Postural errors and congenital abnormalities of the lumbo-sacral region are predisposing causes. The sacro-iliac or lumbo-sacral joints may be the seat of osteo-arthritic changes, or of inflammatory disease such as tuberculosis. A careful examination is always made to exclude tuberculosis, which is insidious in onset and may simulate a simple strain. It is also borne in mind that ankylosing spondylitis is first manifest in the sacro-iliac joints.

Sacro-iliac strain. *Clinical features.* There is pain and tenderness referred to the sacro-iliac joints pain is aggravated by changing from sitting to standing and vice versa, by turning in bed, and by compression of the pelvis between the surgeon's hands. The gait is careful movements of the spine are guarded, and there may be a list of the whole spine towards the unaffected side.

Treatment usually consists of a plaster jacket or strapping support If this relieves the pain, a supporting belt may be ordered, similar to the one shown in *Fig 110 The belt is* gradually discarded as the symptoms subside Exercises are generally ordered, and Novocain injection is sometimes advised. Operative *fusion of the affected joint is sometimes performed* in cases which do not respond to conservative treatment.

Lumbo-sacral strain. *Clinical features.* Pain and tenderness is referred to the lumbo-sacral junction and there is limitation of spinal movement in all directions.

Treatment proceeds on the lines already described for sacro-iliac strain.

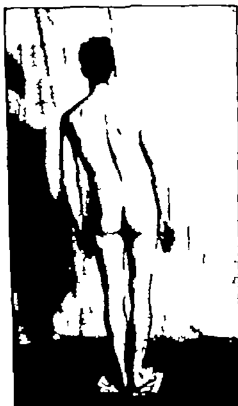


Fig 158.
Sciatic scoliosis with list of spine to the left. (*Watson Jones*)

Sciatic scoliosis. This deformity consists of a total list of the spine to one side (Fig 158). It is the posture adopted by the patient in an effort to relieve sciatic pain which may be due to strains of the sacro-iliac or lumbo-sacral joints, or of the muscles or ligaments, or to irritation or compression of nerves by rupture of an intervertebral disc.

Rupture of an invertebral disc occurs in young adults,

and is more common in men than women There is lateral and backward displacement of the disc, so that a nerve is subjected to pressure and friction, and sciatica results. The fifth lumbar and first sacral nerves are most commonly affected.

Clinical features. There is sometimes a history of injury often in the nature of a sudden strain while in the stooping position, as in lifting a weight. The patient feels a sudden snap in the back, followed by a sharp pain in the lumbo-sacral region. Sciatica then develops either immediately or after a few days. There is agonising pain, aggravated by sneezing and coughing and by turning in bed. Pain is referred down the back of the thigh and calf to the outer side of the ankle and the outer side of the sole of the foot and this may be accompanied by tingling and numbness. There is rigidity of the spine, loss of the normal lumbar lordosis, and sciatic scoliosis may be present. Straight leg raising is limited and painful In many cases the ankle-jerk is absent.

Treatment. Simple rest in bed may be sufficient in some cases Pugh's traction is sometimes advised. A plaster jacket or spica may be ordered A plaster jacket may be applied in head-suspension, as shown in Fig. 14 Weight-bearing in plaster is generally allowed after a few days. The plaster is worn for about three months and a supporting belt of the Goldthwait type is prepared pending its removal. This may be worn for an indefinite period. Back raising exercises are generally ordered.

Operative treatment If the symptoms are not relieved by conservative means, or if there is recurrence of symptoms, operative treatment may be advised. This consists of removal of the ruptured disc with or without spinal fusion

After treatment may consist of back raising exercises, and a supporting belt the patient is advised to avoid heavy lifting whilst in the stooping position for about six months.

CHAPTER XX

EPIPHYSEAL LESIONS

Epiphyseal coxa vara. Symptoms and signs. *Aim of treatment.* Conservative treatment. Frame fixation and skin traction. Methods of maintaining internal rotation of the hip. Nursing care. Sliding bed traction. Later treatment. Operative treatment. Perthes' disease. Symptoms and signs. X-ray changes. Treatment. Splintage. Convalescence. Scheuermann's disease. Symptoms and signs. Treatment. Correction of deformity by means of hyper-extended frame. Nursing care. Physiotherapy. Application of a spinal support. *Later treatment. Other epiphyseal lesions.* Osgood-Schlatter's disease. Kohler's disease. Sever's disease. Freiberg's disease. Keinbock's disease.

EPIPHYSITIS or osteochondritis, is a non-inflammatory disturbance of the epiphysis occurring during the period of growth, i.e. in childhood. The cause is obscure.

EPIPHYSEAL COXA VARA

(Slipped upper femoral epiphysis)

This is a separation of the upper femoral epiphysis occurring mostly in boys aged ten to seventeen years. They are often of the obese type. The condition may be unilateral or bilateral.

Symptoms and signs. There is seldom any impairment of the general health. A history of previous injury such as a fall or blow is not uncommon. The onset is gradual, with fatigue on slight exertion, accompanied by a limp. Pain is present in the hip-joint or referred to the knee. Later the limb is turned outwards and there is a waddling gait. On examination, the hip is found to be held in external rotation and adduction, and the femur passes into external rotation as the hip is flexed. There may be muscle spasm, and internal rotation and abduction is limited or absent. Late cases may show flexion contracture of the hip, and real or apparent shortening.

X-ray changes. Antero-postero and lateral views of both hips are required. (1) X-rays in the very early or *preslipping* stage show increased density and fluffiness of the epiphysis. (2) Once separation has occurred, the femoral head may be

rotated until its lower and posterior borders are displaced backwards and downwards. (3) In advanced cases, the articular surface of the femoral head is displaced inwards, backwards and downwards, and the head may lie loose in the acetabulum.

Aims of treatment. To replace the displaced epiphysis, to maintain reduction until fusion takes place and to retain the function of the joint

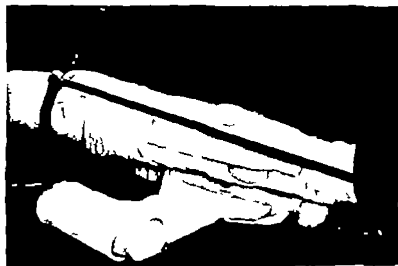


Fig 150
Method t ppl g strappi g to ma t ternal rot tion t the h p joint A thick pad f wool placed over the knee before bandagi g

Treatment i l by t ng factors —
(a) The *deg* ation *duration* of the separation It m ative ve

nursed exactly as described for tuberculosis of the hip-joint (Chap XI) with the following additions.

The position of the limb is decided by the surgeon. It is usually abduction and internal rotation Abduction is maintained by the frame itself, but internal rotation must be secured and maintained by the following means.

Bandaging In mild cases, this may be sufficient. A thick pad of wool is placed over the knee and bandaging is commenced from without inwards and must be tight enough to maintain internal rotation *at all times*



Fig 160.

Patient immobilised on abduction frame with sliding-bed traction and internal rotation strapping. The skin extensions are tied to the fixed part of the elevated foot end of the bed. Very heavy traction can be applied by this method. Note that in this case the frame is ill fitting It is too long in the leg and the knock knee bars do not lie in the long axis of the limb.

Strapping Take a piece of Holland or other adhesive strapping, of sufficient width to extend two to three inches above and below the knee joint Lay it on the outer side of the knee cutting a hole for the patella, and carry it around and underneath the knee as shown in Fig 159 The free end is then stitched to a bandage which is continued round the knock knee bar of the frame in the usual way or stitched to a bandage or piece of ticking which is tied to the knock knee bar of the opposite side of the frame, as shown in Fig. 160 Alternatively

it may be attached to a cord carrying a weight which runs over a pulley fixed to the opposite side of the bed.

Nursing care. The daily care is as already described. In addition, special attention must be paid to the following points —

(1) Be sure that the corrective bandaging or strapping is in fact maintaining internal rotation *at the hip-joint* not merely exerting strain on the knee-joint and producing a knock-knee deformity

(2) Though bandaging and strapping must necessarily be tight, it must not be allowed to interfere with the blood or nerve supply to the foot The external popliteal nerve is very liable to become pressed upon where it winds round the neck of the fibula. The foot must be inspected at frequent intervals and *no complaint of pain tingling, numbness or inability to dorsi* flex the foot must be ignored. Should it occur corrective ban daging must be adjusted at once whilst an assistant steadies the limb in the desired position.

N.B The sound hip is examined from time to time as the epiphysis on that side may slip even during immobilisation.

Sliding bed traction. This is usually combined with frame fixation, skin traction and corrective bandaging or strapping as already described The frame is tied to the sliding portion *of the bed, but the extensions are tied to the fixed part so that* strong traction is obtained (Fig 160)

Later treatment. Fixation and traction is continued until reduction and fusion of the epiphysis has taken place Exer cises for the general musculature and those which encourage internal rotation and abduction of the hip-joints are commenced and weight bearing is gradually introduced.

Operative treatment may consist of the following —

(1) *Reduction and internal fixation*

(a) Manipulation and insertion of a Smith-Peterson pin, or (b) Open reduction and insertion of a Smith Peterson pin. Weight bearing is not allowed until fusion of the epiphysis has occurred, and it is usual to remove the pin at some later date

(2) *Osteotomy* may be advised in those cases in which fusion has occurred in deformed position

(3) *Arthrodesis* of the hip-joint may be performed in those cases in which arthritis has supervened, as when interference with the blood-supply has produced aseptic necrosis of the femoral head.

PERTHE'S DISEASE

(Legge-Calve Perthe s disease, pseudo-coxalgia)

This is an affection of the upper femoral epiphysis occurring mostly in boys between the ages of five and ten years. It may be unilateral or bilateral, and is characterised by certain changes in the femoral head and neck. It is thought that these changes are due to impairment of the blood supply to the femoral head, and that this may be of traumatic infective or endocrine origin. It has been noted that Perthe s disease may occur following forcible manipulation of a congenital dislocation of the hip-joint

Symptoms and signs. The general health and vigour is unimpaired A limp is usually the first thing to be noticed, and is of a carefree stomping nature as opposed to the painful hesitant limp which occurs in tuberculosis of the hip-joint Pain is not a marked symptom, though it is usually present in some degree and may be referred to the knee On examination, there will be limitation of *abduction and internal rotation* as opposed to tuberculosis of the hip-joint in which there is limitation of *all* movements. In addition, pain and muscle spasm is never so marked In cases of very long standing, there may be flexion contracture of the hip-joint

X-ray changes. Serial X rays of a typical case of Perthe s disease will show three stages —(1) Sclerosis. (2) Fragmentation and mushrooming. (3) Recalcification and healing The three stages merge gradually into each other and the whole disease process, from the time of onset to complete recalcification, is thought to occupy from two to three years. Most cases are treated in hospital for at least two years.

Stage 1 *Sclerosis.* In early Perthe s disease the femoral head will be of *increased density* in the X ray film. This is due to the impairment of the blood-supply with local death of the head In bone local death is spoken of as "sclerosis" or avascular necrosis There may be flattening and broadening

of the femoral head, and sometimes, changes in the neck and acetabulum. Coxa vara (decrease in the angle between femoral neck and shaft) is almost always present in some degree

Stage 2. *Fragmentation and mushrooming* As the blood supply begins to be re-established, islands of rarefaction appear in the dense bone giving it a moth-eaten appearance If weight is borne on the femoral head, gross flattening and distortion will occur which is aptly named mushrooming

Stage 3. *Recalcification and healing* The blood-supply is re-established and the areas of rarefaction and sclerosis are gradually replaced by normal bone

Treatment. This is aimed at the prevention or correction of deformity and the preservation of the normal contours and function of the hip-joint This is achieved by the prevention of weight bearing and by the relief of pressure on the femoral head by muscle-pull.

The general health must be kept at a high level. As the period of hospitalisation is long an open-air life and continued education in the company of other children is obviously desirable Treatment varies according to the X ray signs and the surgeon's wishes. Frequent X rays are taken so that the progress of the disease can be closely watched

Recumbency Some surgeons maintain that to keep the child off his feet is sufficient but as the period of recumbency must necessarily be uninterrupted and prolonged in any case some form of splintage is usually ordered.

Splintage (1) *Jones double abduction frame* skin extensions. The application and nursing care is exactly the same as that already described for tuberculosis of the hip-joint in Chap XI The degree of abduction is decided by the surgeon. Frame fixation is usually continued until revascularisation of the femoral head is established (generally eighteen months to two years) when the patient is either allowed free in bed, with the legs supported on pillows, or some less stringent form of fixation is substituted for the frame

(2) *Pugh traction* This is applied and nursed as already described in Chap. XI

(3) *Broomstick plasters* These are occasionally ordered in those cases in which the femoral head has commenced to flow out of the acetabulum. They are applied in full abduction and internal rotation, and it is thought that the re-calcifying femoral head is moulded by the movement of the pelvis on the femora as the patient sits up (Fig 161) The nursing care has already been described in Chap. XI special care is necessary with regard to the prevention of deformity Some laxity of the knee-joints is certain to occur due to stretching of the hamstrings,

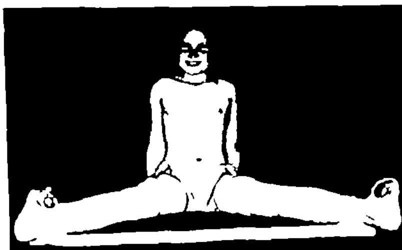


Fig 161.
Broomstick plasters applied in full abduction and internal rotation.

and the position of internal rotation predisposes the knee to genu valgum owing to the constant pressure of the plaster on its outer side Quadriceps drill should be practised throughout Scoliosis must be guarded against and the patient should spend at least half the day in the prone position. (Fig 142.) Back raising exercises are practised intensively

Convalescence. When recalcification of the femoral head is complete all splintage is removed and the child allowed to kick free in bed with a pillow under the knees to prevent hyperextension Non weight bearing exercises for all muscle groups are practised, but kneeling or standing is strictly forbidden. When the musculature is good and the bone-texture

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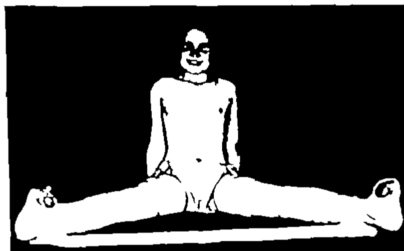


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Convalescence. When recalcification of the femoral head is complete all splintage is removed and the child allowed to kick free in bed, with a pillow under the knees to prevent hyperextension. Non-weight bearing exercises for all muscle groups are practised, but kneeling or standing is strictly forbidden. When the musculature is good and the bone-texture

of the femoral head is normal, weight bearing is gradually introduced. A caliper is occasionally ordered. Correct balance is first taught followed by re-education in walking Exercises and games are continued throughout. In early cases, prolonged fixation and traction followed by re-education usually produces a very satisfactory end result Even in cases where treatment has been instituted very late a good functional result is to be expected. If however there is gross flattening and distortion of the femoral head with disorganisation of the joint surfaces, arthritic changes will almost certainly supervene in later life, giving rise to such pain and stiffness as to necessitate arthrodesis or arthroplasty of the hip



Fig 162.
Adolescent kyphosis.
(Same case as Figs. 163 and 164)

SCHEUERMANN'S DISEASE
(Adolescent Kyphosis)

This is an osteochondritis of the spine occurring in children aged twelve to sixteen years.

Predisposing causes (a) Poor general musculature (b) Poor posture (c) Rapid growth

Symptoms and signs. The onset is insidious, with fatigue pain in the back, and gradually increasing kyphosis. The patient is often tall for his age and of the type of whom it is said that he is outgrowing his strength The lower dorsal spine is the commonest site of the disease and there may be a localised kyphos in this region. The shoulders are rounded and the pectoral muscles may be contracted, with a flat chest and a poking chin. The hamstrings are frequently found to be tight

X ray examination reveals wedging of the affected vertebrae and sclerosis of the epiphyses.

Treatment. This is aimed at the resto[illegible] normal

contours and function of the spine It consists of hyperextension of the spine on a straight frame followed by a spinal support and re-education of the general and spinal musculature The general health receives attention.

Splintage A straight frame with a saddle and straight or sunken head piece Alternatively a plaster bed may be used as described for ankylosing spondylitis (Chap XVIII)

The preparation of the patient and the frame and the

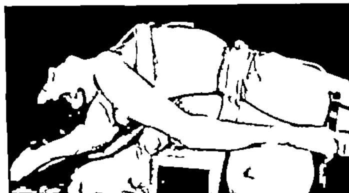


Fig 163.

Dorsal kyphosis due to Scheuermann's disease corrected by means of a hyperextended frame (Same case Figs 162 and 164) The frame is hyperextended opposite to the apex of the kyphos.

method of immobilisation is as already described for tuberculosis of the spine in Chap X

Hyperextension of the frame. After a few days, when the patient has become accustomed to frame fixation, he is turned and the frame is marked opposite to the point of maximal deformity It is then sent to the splint maker and hyperextended to the degree ordered, e.g. 10 The patient is refixed on the frame in the usual way and it will now be necessary to support the frame on blocks, placed under the shoulders the hips and the knees. The frame is then further hyperextended every few days, until there is clinical and radiographic evidence of correction of the deformity Fixation in hyperextension is usually continued for about three to six months. (Fig 163)

Nursing care. This is already described in Chap. X. The following points should be noted —

(1) *General care* As a rule these patients are phlegmatic children and tolerate their treatment well Occasionally however sedatives are needed in the early stages and abdominal upsets may occur due to the altered position.

(2) *Care of splintage* The frame must be supported on blocks so that the headpiece does not touch the bed. Unless the blocks are very substantial and are grooved to fit the frame the patient feels that his position in bed is precarious and unsafe It is therefore advisable to pack the spaces between the blocks with hard pillows. These also prevent the frame yielding to the patient's weight and add to his comfort by preventing draughts.

Arm pillows must not be used if the pectoral muscles are tight A pillow under the head may or may not be allowed, according to the individual case.

Physiotherapy If the deformity is severe and the musculature feeble it may be thought advisable to continue immobilisation for a month or so before exercises are commenced. In the majority of cases, however and certainly in those in which deformity is not pronounced and the musculature is reasonably good daily exercises off the frame are advised Good results are achieved by this method, as the muscular development then keeps pace with correction of the spinal deformity and muscle-wasting from disuse is avoided.

Method The patient is lifted to the side of the bed and pillows are arranged so that the hyperextended position of the spine is not lost He is then lifted en masse from the frame on to the pillows. In this position he is given breathing abdominal, and leg exercises. He is then turned on to his face (*still maintaining hyperextension of the spine*) and given back raising exercises, as well as those designed to strengthen the gluteal muscles. In addition head, arm and foot exercises are given so that the entire musculature is developed. Special stress is laid on re-education of the erector spinae and the patient is taught postural control so far as is possible whilst lying in bed.

Application of a spinal support. This is fitted as described

in Chap. X, and the skin is treated in the same way. Special attention must be paid to the following points:—

(1) There must be sufficient hyperextension of the spine *at the level of deformity* to ensure its continued correction.

(2) *The support must not be so moulded in the lumbar region as to produce an exaggeration of the normal curve.*

At the first application, it may be impossible to fit the support closely in this region without producing a lordosis. This must be avoided at all costs. Provided sufficient hyperextension occurs at the level of deformity no harm will be done even if the support does not conform closely to the lumbar spine. Once weight bearing, general postural training and further re-education of the abdominal muscles is instituted, it will be found that the lumbar spine will adjust itself to the support without exaggerating its curve and the normal alignment of the spine is preserved. A plaster jacket may be used instead of a spinal support.



Fig. 164.
Same patient as shown in Figs. 162 and 163 wearing spinal support.

Later treatment. *Physiotherapy* is continued, and general postural training and re-education in walking is essential. The development of pride in the appearance is a great asset.

On discharge the patient must thoroughly understand the necessity for the continuation of exercises over a long period. Games and activities which improve the general posture, e.g. dancing, should be encouraged. When full healing of the affected epiphyses has occurred, the support is gradually discarded.

CHAPTER XXI

RICKETS

Pathology. Symptoms and signs. Skeletal deformities. Treatment. Preventive measures. Medical treatment. Orthopaedic treatment. Operative treatment.

RICKETS is a deficiency disease of childhood. It is due to lack of Vitamin D either because of inadequate diet or insufficient sunlight. It is characterised by skeletal deformities, which are however only one aspect of a general constitutional disorder. At one time it was common in industrial areas, but since the introduction of cod liver oil for children in 1917 rickets in its active state is rarely seen, though many children may pass through a mild attack.

Vitamin D is found in cod liver oil and in certain fatty food-stuffs: it is also manufactured in the skin by the action of ultra violet rays, as found in sunlight. Its role is to promote the absorption of fats from the alimentary tract and thereby facilitate the absorption of calcium salts. When this process is disturbed, bone formation is impaired: the orderly replacement of cartilage by bone in the epiphysis is upset with the result that this region becomes expanded and the bone formed is soft and pliable. Under the stress of weight-bearing and muscular activity the bones become bent and curved, and the whole skeleton may become stunted.

Symptoms and signs. The child is usually between the ages of six months and two years: thereafter activity of the disease ceases, but the effects on the skeleton may be permanent. The child may appear well nourished, and in fact is often heavy, flabby and pale. He is disinclined to move or be moved and standing and walking is attempted late: dentition is delayed. Recurrent bronchitis and diarrhoea is common and there may be nervous symptoms, such as convulsions. There is excessive sweating of the head and upper part of the body with disturbed sleep and fretfulness. In severe cases, muscle wasting and muscle weakness is marked. The glands and spleen may be enlarged, and anaemia may be present.

Skeletal deformities. *The skull* is broadened, the forehead is square broad and bossy and the fontanelles are late in closing

The thorax There is enlargement of the costo-chondral junctions, producing the so-called rickety rosary The ribs bend with respiration and a pigeon-chest may be present especially if there is also kyphotic deformity of the spine.

The lower ribs may be sucked in, forming a groove known as Harrison s sulcus

The spine Kyphosis is the most common deformity though scoliosis is sometimes seen.



Fig 165.
Rachitic tibial bow-leg

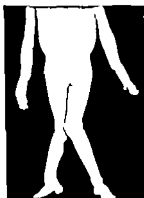


Fig 166.
Rachitic knock knee
Note the pot belly and enlargement of the epiphyses.

The femur The normal forward and outward bowing becomes exaggerated. The femoral neck yields to weight bearing producing coxa vara.

The tibia is bent forwards and outwards. Bowing of both femur and tibia may be present producing genu-varum (bow leg) (Fig 9) or bowing may be confined to the tibia only when it is spoken of as tibial bow leg (Fig 165) On the other hand, genu-valgum (knock-knee) may be present (Fig 166) or the deformities may be combined (i.e knock-knee on one side and bow leg on the other) in a child who has been carried on his

mother's arm (Fig. 167) In addition there is broadening of the epiphyses, especially of the lower ends of the radius and tibia.

The pelvis assumed a trefoil shape It is flattened and its diameter is lost This may prove a serious obstacle to child bearing in later life

X rays during the active stage show broadening and blurring of the epiphyses. Later the bone-ends are broadened and have a scooped-out appearance and deformities such as coxa vara may be evident



Fig. 167
The result of untreated rickets. Right leg—genu varum. Left leg—genu [illegible]

The typical appearance of the rachitic child has been summarised as follows —The brow of a philosopher the chest of a pigeon the legs of a grand piano, and the belly of a poisoned pup

Treatment. *Preventive measures* include breast feeding followed by a full adequate diet rich in those foods containing Vitamin D especially milk and butter The administration of cod liver oil should be continued at least until the age of three years, and the growing child should be exposed to fresh-air and sunlight Treatment of the established condition is both *medical and orthopaedic*

Medical treatment is aimed at restoring the Vitamin D content and arresting the disease.

(1) *Rest* is essential during the active stage; sitting up crawling or walking is not allowed.

(2) *The diet* will be as ordered by the physician and will be rich in those foods containing Vitamin D

(3) *Sunlight* either real or artificial will be given in carefully graduated doses.

(4) *Cod-liver oil* or halibut liver oil will be given on the advice of the physician. Other preparations may be ordered

(5) *Treatment of other manifestations of the disease* e.g. bronchitis or anaemia will be carried out according to the instructions of the physician.

Orthopaedic treatment is aimed at the prevention or correction of deformity.

Mild cases, with little or no deformity, require just sufficient splintage to prevent the child sitting up or standing. An ordinary restrainer may be used in conjunction with either metal or plaster gutter splints for the lower limbs. These are removed several times daily for treatment of pressure points and for gentle exercises to preserve the musculature.

Severe cases, in which the bones are still soft but there is established deformity, are treated according to the part affected.

Deformity of the spine requires immobilisation on a Thomas straight frame or a plaster bed. The application and care is already described in Chap. X.

Deformity of the pelvis may necessitate a Jones abduction frame with skin traction.

In most cases, deformity of the lower limbs presents the greatest problem.

Knock-knee or *bow-leg* may be treated by the following means.

(a) Gradual correction by manipulation and plaster fixation or by wedged plasters.

(b) Thomas bed-splint with skin-extensions plus corrective bandaging over pads of felt as described in Chap. X. Gentle exercises are commenced as soon as possible. Weight bearing is resumed when activity of the disease has ceased.

Operative treatment may be undertaken when the bones are no longer soft and deformities have become fixed.

(1) *Osteoclasis.* The bone is fractured at the point of maximal deformity either manually or by using an osteoclast. The limb is then fixed in plaster until union is sound.

(2) *Osteotomy* may be performed for correction of deformity.

ACUTE ANTERIOR POLIOMYELITIS

(Infantile Paralysis)

Mode of infection. Symptoms and signs. Aims of treatment. Treatment of acute stage. General nursing care. Prevention of pressure sores. Position of the limbs. The use of a respirator. Cases of bulbar paralysis. Prevention of deformity. Splintage. Paralysis of the muscles of the trunk. Paralysis of the upper limbs. Paralysis of the lower limbs. Paralysis of the hands and feet. Physiotherapy. Baths. Management of convalescent stage. Importance of the nurse's part in re-education. Retentive splintage. Retentive splintage for different regions. Operative treatment. After-care. Summary of treatment.

ACUTE anterior poliomyelitis is an acute infectious disease occurring sporadically and in epidemics, usually in the late summer and autumn. It is caused by the invasion of the central nervous system by a minute filtrable virus. Children are most frequently attacked, but no age-group is immune. The incubation period is thought to be from one to five days.

The virus is believed to enter the body via (a) the respiratory tract (by inhalation) or (b) the alimentary tract (by ingestion). There are two main types: (a) the *bulbar type* affecting the brain-stem, (b) the *spinal type* affecting the spinal cord. It is the last named which chiefly concerns the orthopaedic nurse, though both types may be present in the same individual.

The virus enters the spinal cord via the nerves and the blood-stream. There is hyperaemia of the cord with extensive inflammatory exudate and oedema. The anterior horn cells are either pressed upon by the products of this inflammation or they may be partially or completely destroyed by the toxic
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nerates, the muscle supplied by it is partially or com-
d of its nerve-supply and flaccid paralysis ensues.
ay be affected. Sensory changes are rare.

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r some other disease of

childhood. Sore throat and enlargement of the cervical lymph glands is usually present There is pyrexia and the patient is flushed, irritable and apprehensive He dislikes being touched and complains of pain in the back and limbs. Muscle tenderness may be present with tremors, weakness and unsteadiness of voluntary movements, and sometimes, muscle-spasm Meningeal symptoms include headache, convulsions, drowsiness, or even delirium. *Neck rigidity is an important diagnostic sign.* Gastro-intestinal upsets are common, and there may be anorexia, nausea, vomiting diarrhoea or constipation. Retention of urine frequently occurs. Lumbar puncture may reveal the presence of increased cells and protein in the cerebro-spinal fluid.

Paralysis commonly occurs from one to three days from the time of onset and varies from weakness of one muscle to complete paralysis of the trunk and limbs the respiratory muscles or the muscles of deglutition may be involved. Certain muscles are particularly liable to be picked out notably the quadriceps, the anterior tibial group the peronei and the deltoid. The last named rarely recovers. As the inflammation in the spinal cord subsides, those nerve cells which are not actually destroyed are released from pressure and the muscles supplied by them gradually recover

Aims of treatment. (1) To save life. (2) To prevent deformity and minimise disability

Treatment of acute stage

The patient is received into a warm bed in a warm, well ventilated room, or into a ward reserved for these cases, and is nursed on a Dunlopillo or other soft mattress supported by a fracture board The weight of the bedclothes must be supported. The following articles should be held in readiness —(1) a respirator of the Paul Bragg or Drinker type (2) an oxygen cylinder (3) stimulants (4) a lumbar puncture tray; (5) a sucker in case of pharangeal paralysis.

Isolation This must be observed for from three to six weeks, masks and gowns being worn by the attendants. Careful scrubbing up is necessary before leaving the sick room. Excretions and soiled linen should be dealt with as for typhoid fever

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(Infantile Paralysis)

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Symptoms and signs. These may be so slight at first as to be confused with a feverish cold or some other disease of

childhood Sore throat and enlargement of the cervical lymph glands is usually present There is pyrexia and the patient is flushed, irritable and apprehensive He dislikes being touched, and complains of pain in the back and limbs. Muscle tenderness may be present with tremors, weakness and unsteadiness of voluntary movements, and sometimes muscle-spasm. Meningeal symptoms include headache convulsions, drowsiness, or even delirium. Neck rigidity is an important diagnostic sign. Gastro-intestinal upsets are common, and there may be anorexia nausea, vomiting diarrhoea or constipation. Retention of urine frequently occurs. Lumbar puncture may reveal the presence of increased cells and protein in the cerebro-spinal fluid.

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Isolation. This must be observed for from three to six weeks, masks and gowns being worn by the attendants. Careful scrubbing up is necessary before leaving the sick room. Excretions and soiled linen should be dealt with as for typhoid fever

General nursing care. The patient should not be left unattended, especially if there is involvement of the respiratory muscles or of the muscles of deglutition. The temperature pulse and respiration is recorded four hourly and any cyanosis, dyspnoea or difficulty in swallowing reported at once. A respirator is not used unless absolutely necessary as the patient tends to become dependent upon it. Artificial respiration and the use of oxygen *may tide the patient over a period of dyspnoea* without resort to other means.

Retention of urine is common and catheterisation may become necessary

Abdominal upsets will be dealt with on the advice of the surgeon. Constipation is common and may require the administration of enemata. Liquid Paraffin may be ordered. Abdominal distention may require the use of a rectal tube and injections of Pituitrin. Acute dilation of the stomach sometimes occurs *A light nourishing diet is given and fluids administered* freely The mouth should be cleansed after each feed.

The relief of pain. Sedatives are usually ordered, or the application of hot wet packs Warmth is important at all stages of treatment and *the limbs must never become cold.* Moist heat is usually more efficacious than dry heat, though well-covered hot water bottles may be used

Meningeal symptoms necessitate a quiet, darkened room and the use of sedatives.

Prevention of pressure sores. These quickly occur because of the impaired nourishment of the skin and the inability to move the limbs. They should be guarded against from the first moment by the following measures —

(a) A sponge-rubber mattress judicious arrangement of the limbs on pillows so that bony prominences (e.g the heels and elbows) are relieved from pressure.

(b) Areas subjected to pressure must be kept scrupulously clean and dry and should be treated four hourly by rubbing with soap and water

The position of the limbs. The limbs are arranged in the position which rests the affected muscles and prevents them from becoming overstretched If the upper limbs are affected, they

are supported on pillows and must not be allowed to drop by the sides. The wrists and hands are supported in the neutral position. The lower limbs are supported in a neutral position with the legs in a comfortable degree of abduction and the knees in slight flexion. The feet should be supported in dorsi flexion by means of pillows. Light plaster or metal splints are frequently ordered for the hands and feet

Careful handling is important at all stages of the treatment especially in the acute stage when muscle tenderness and spasm may be marked. The limbs should always be supported in their entirety e.g. never lift a leg by grasping the foot only

The use of a respirator If a respirator is used, the correct position of the limbs must still be maintained nursing care is carried out through the windows. Frequent change of position within the limits of correct orthopaedic treatment may be necessary to prevent hypostatic pneumonia. Every effort should be made to encourage the patient not to become dependent on the respirator by gradually increasing the periods spent out of it The nurse must adopt an attitude of calm assurance and tact and firmness is necessary in dealing with those patients whose cerebral irritation gives rise to loss of self-control and hysterical outbursts.

Cases of bulbar paralysis require general care as already described. In addition, these patients are unable to swallow mucus and saliva and the pharynx must be kept free from these secretions by postural drainage (i.e. the patient lies on his face with the foot of the bed elevated) and by the use of an electric sucker Oxygen may be ordered. Fluids are given by rectum or by vein, and it may be necessary to resort to nasal feeding Absolute quiet is essential. Tracheotomy may be necessary in extreme cases. The death rate in bulbar palsy is higher than in the spinal type but recovery tends to take place more rapidly and to be more complete

Prevention of deformity Deformity is due to the following —

(1) *Bad posture* a paralysed limb which is constantly held in a certain position will eventually adopt that position permanently

(2) *The action of gravity* for instance an unsupported paralysed foot assumes the drop-foot position, which may eventually become fixed

(3) *Muscle imbalance* If one muscle or group of muscles is paralysed or weak, and its opponent functioning normally the healthy muscle will pull the limb into a deformed position for example if the peronei group is paralysed and the tibialis anticus and posticus functioning normally the foot is held in the inverted position.

(4) *Muscle contracture* if as in the example given above the unopposed invertors were allowed to become contracted, the inversion deformity would become fixed

Deformity can therefore be prevented by the following measures —

(1) By maintaining correct position of the limbs.

(2) By eliminating the action of gravity by supports.

(3) By preventing overstretching of paralysed muscles and the contracture of healthy ones by —(a) splintage; (b) by preserving full mobility of the joints (c) by re-education of the weakened or paralysed muscles.

Splintage. This is applied according to the surgeon's orders, and should be as light and simple as possible and unless there is incipient deformity either from the action of gravity or from muscle imbalance the use of pillows and sandbags may be sufficient, though light plaster shells or gutter-splints for the hand or foot are usually ordered. (Fig 168.) It must be remembered, however that stiffness of joints must be prevented at all costs, and splintage must never be so rigidly applied as to produce this.

Paralysis of the muscles of the trunk. In cases of wide-spread paralysis, a frame or plaster bed may be ordered for a short time particularly if the abdominal muscles, the erector spinae and gluteal muscles are affected. A plaster bed is comfortable and affords physiological rest with ease in nursing and in examination of the patient. The method of making a plaster bed will be found in Chap. IV The patient lies comfortably the hips in extension and sufficient abduction to allow for nursing purposes, unless the gluteus medius and minimus are

affected, when more abduction may be ordered. Further nursing details will be found in Chap X. If the neck muscles are affected, a headpiece is incorporated in the plaster bed. The ears and the back of the head must be watched for pressure, and the eyes and nose kept clean. The neck must be comfortably supported and no daylight should be visible between it and its support. Paralytic torticollis may result from paralysis of one sterno-mastoid muscle.



Fig 108

Poliomyelitis affecting all four limbs. Plaster shells are used for the hands and the arms are supported on pillows. Note that the foot shells are very shallow at the heel, so that there is no doubt as to the position of the foot. Deep shells may lead to contracture of the tendo achilles.

Paralysis of the upper limbs. If the upper limbs as well as the trunk are involved, arm pieces are occasionally incorporated in the plaster bed to rest the affected muscles, otherwise the arms are supported on pillows. The most usual position is hand in front of mouth i.e the shoulder is abducted (below the right angle) in a little external rotation and forward flexion, the elbow is held in right angled flexion the forearm in mid position and the wrist in dorsiflexion. *The shoulder joint depends on the muscles around it for its support and great care should be taken lest it becomes dislocated*

Should the upper limbs only be affected, they may be sup-

ported in either a single or double abduction splint. This is, however an uncomfortable splint to wear in bed and is not usually ordered until the patient becomes ambulant. It is usually sufficient to support the limbs on pillows. In children, the sleeve of the night-gown can be pinned to the pillow or the wrist can be tethered to the top of the bed by a clove-hitch. If an abduction splint is ordered, the patient is most comfortable sitting up with pillows packed beneath the splint. If only one splint is worn, the patient particularly if a child, must be watched for scoliosis, as he tends to lean to one or other side. This is especially important when the child gets up particularly if the splint is too short and does not grip the pelvis firmly.

Paralysis of the lower limbs. The knees are supported in 5 of flexion and must be watched for hyperextension. The feet are supported in plaster shells, usually in a neutral position unless there is over-activity of one or other muscle groups, when either inversion or eversion may be necessary. In most cases the foot is held at a right angle and in neutral rotation. Careful watch must be kept for signs of pressure at the top of the shell, where it may press against the calf. The malleoli, the heels and the metatarsal heads are also liable to pressure. The circulation of the toes must be watched and bandages must be firm enough to maintain the position but not tight enough to press on what may already be atrophied muscle. Plenty of wool must be used and *no complaint of discomfort must be ignored even if it means removing the shells several times a day*.

Paralysis of the hands and feet. If the hands and feet only are affected, plaster shells can be made. Be sure that these preserve the normal arches of the hand and foot. The most usual position for the hand is —wrist dorsiflexed, slight flexion at all other joints, and the thumb in opposition (i.e. as in holding a tumbler).

Physiotherapy. The surgeon will decide when the individual case is ready to begin physiotherapy. *As soon as possible* passive and active assisted movements are ordered. All joints are put through their full range several times daily in order to prevent joint stiffness and muscle contractures, and to preserve the joint and muscle sense. It is of vital importance that

full mobility of the joints is preserved, so that recovering muscles have movable joints on which to work, and contractures resulting in deformity will not occur. As soon as the patient is able to co-operate active movements are commenced, which gradually progress to intensive re-education as the acute condition subsides and recovery begins. Hot wet packs may be given by the physiotherapist to relieve pain and spasm and to prevent contracture. As soon as the general condition allows, the patient may be lowered into a warm bath for movements to be given.

Baths are valuable at all stages of treatment. The warmth assists recovering muscles, and as the buoyance of the water overcomes gravity, weakened muscles can perform movements which would otherwise be impossible. Muscles are re-educated at first in their inner range, e.g. the foot is held in a position midway between dorsal and plantar flexion and the patient is encouraged to pull the foot into dorsiflexion, thus using the anterior tibial group of muscles in the inner part of their range. In addition, where possible the movement should be assisted by gravity, or gravity should be eliminated, e.g. the above exercises would be given with the patient lying on his side (in suitable cases) with the foot supported on a smooth surface, thus eliminating the action of gravity. Gradually exercises in slings may be introduced and these directed towards the restoration of function and eventual weight bearing. Massage and electrotherapy may be ordered, but no external stimulation can take the place of active voluntary movement.

Fatigue and boredom must be avoided at all stages of the treatment: physiotherapy sessions *should be short and frequent* and a muscle-chart is kept so that progress can be accurately assessed.

Management of the convalescent stage

This is directed towards improving the function of the limbs, and during this time the patient should be viewed not only as an orthopaedic problem but as a social and economic one. Every effort must be made to prepare the patient for the resumption of normal life.

Physiotherapy is continued throughout and is directed at this stage to the improvement of function so as to allow the

patient to dispense with splintage as far as possible. Exercises in a swimming bath are of the utmost value and games and activities amongst others are encouraged. Trick movements are often developed which compensate for those which are lost.

Importance of the nurse's part in re-education. Though formal exercises are the prerogative of the physiotherapist, the nurse must also play her part in teaching and encouraging her patient to attend to his own needs, and to become independent of others. Patients who have had widespread paralysis with severe meningeal symptoms require careful handling as they frequently develop a temperament and become emotionally unstable excitable and hysterical. Suitable occupation and congenial surroundings must be found for them

Retentive splintage. If there is still residual disability after a long period of convalescence combined with re-education, retentive splintage may be ordered. It should be as light and simple as possible and it must be remembered that circulatory changes in the skin may predispose the patient to splint sores. Retentive plasters are not as a rule ordered as they are necessarily heavy and tax the patient's already weakened muscles too heavily Also re-education of muscle is well nigh impossible inside closed plasters. Extensive paralysis may result in short ened, wasted limbs, with slender rarefied bones and unduly mobile joints. This type of patient often becomes excessively thin, but on the other hand, there may be large deposits of subcutaneous fat due to the restricted activity and inability to take exercise The last named type is particularly difficult to manage with regard to splintage Circulatory changes are almost always present in both types and the affected limbs become cold and blue.

Splintage is very carefully chosen for the individual patient In cases of widespread paralysis, various appliances or combinations of appliances may be tried out before a satisfactory result is obtained Even when no further recovery of muscle power is expected efforts to improve the *functional use* of a limb are not relaxed.

Retentive splintage for different regions. *The upper limbs.* An abduction splint may be ordered for paralysis of the shoulder muscles and plaster shells are used for the hand. Splintage for

the upper limb is discarded as soon as possible so that *functional use* can be encouraged.

Paralysis of the trunk muscles Paralysis of the spinal muscles may necessitate a spinal support which may be com-

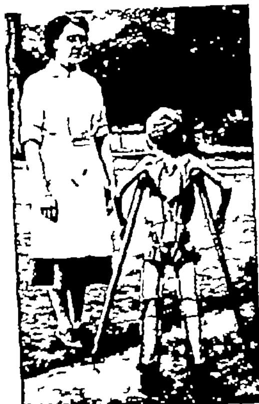


Fig 169.
Extensive paralysis of the legs and trunk due to poliomyelitis. The patient is wearing spinal support strapped to two calipers which combined with crutches enables him to progress with tripod gait.

bined with an abdominal belt if weakness of the abdominal muscles causes an extreme lordosis, as shown in Fig 73. In paralysis of the gluteus maximus, the spinal support must be strapped to two calipers in order to allow the patient to achieve the upright position. (Fig. 169.) The patient may be taught to walk on crutches, though these may be replaced by sticks

if the muscles of the upper limbs are strong Unequal recovery of the muscles of the trunk will inevitably result in scoliosis. A block leather support such as is shown in Fig. 117 may then be ordered Unfortunately no splintage has been devised which can overcome the waddling gait associated with paralysis of the gluteus medius and minimus.

Paralysed quadriceps necessitate a caliper to hold the knee in extension. If two are worn one ring must be at a higher level than the other to allow the limbs to pass each other comfortably in walking Plaster shells may be worn at night.

Drop-foot is controlled by an inside outside, or double iron with posterior stops, and a plaster shell for night wear Anterior stops are ordered if the calf muscles are affected, and in inverted or everted foot would require a T-strap on the opposite side to the deformity

Operative treatment. This may be ordered in the late stages. Manipulations may be carried out (for example on the foot) followed by a period of plaster fixation and re-education.

Operations on soft parts. These may be —(1) *Tenotomy* or elongation of tight structures (for example the tendo-achilles) followed by plaster fixation and re-education. (2) *Tendon transplants* which allow a healthy muscle to do the work of a paralysed one and to correct deformities (for example the tibialis anticus is transplanted to the outer side of the foot to correct persistent inversion). If a tendon is transplanted it must be in alignment strong enough for its new task, comparable in function to its predecessor and dispensable to the part from which it is taken. (3) *Operations on bone* This is usually stabilisation of a flail joint (for example the shoulder or foot) It provides a stable joint function is greatly improved, and splintage may be discarded Fusion of the spine may be advised if there is widespread muscle weakness with progressive scoliosis, and operations to equalise the length of the legs are sometimes advised.

Lumbar sympathectomy may be performed if the trophic changes in the lower limbs become troublesome Sometimes the circulatory changes result in deep indolent ulcers which render the patient s life well nigh unendurable and which may neces-

sitate amputation of the lower limbs. An artificial limb can be fitted if the gluteal muscles are strong enough otherwise the patient is restricted to a wheel-chair existence.

After-care. When the patient is discharged from hospital the nurse must instruct the patient or his relatives with regard to the splintage and the care of the skin. Splints, boots and night shells must fit well and be kept in good repair. The patient must be well-clothed and when the circulation in the lower limbs is very bad rabbit-skin gaiters should be worn. Chilblains must be guarded against and the patient warned against extremes of heat and cold. If deformity of the thorax is present as a result of paralysed muscles, the possibility of intercurrent disease such as bronchitis must be borne in mind. Suitable education and employment is arranged so that the patient is not relegated to the chimney-corner.

Summary of treatment

Acute stage

(1) Isolation.

(2) Rest, general and local in a good position splintage to prevent deformity.

(3) Treatment of complications.

(4) Physiotherapy—early passive movements to prevent joint stiffness active movements as soon as possible.

Convalescent stage

(1) Intensive re-education, exercises in baths, etc.

(2) Retentive splintage if required.

(3) Re-education for home and professional life.

(4) Operative procedures.

CHAPTER XXIII

SPASTIC PARALYSIS

(Cerebral Palsy)

Symptoms and signs. Deformities. Mental changes. Treatment. Conservative treatment. Splintage. Correction of deformity in the upper limb. Correction of deformity in the lower limb. Retentive splintage. Physiotherapy. Operative treatment. Post-operative nursing care. After-care

THIS is a lesion of the upper motor neurone, characterised by muscle-spasm, loss of control and co-ordination of movement and deformity. It may be *congenital* or *acquired*.

(1) *The congenital type* or "Little's disease" may be due to an error of development, but as in many cases there is a history of difficult or precipitate birth it is thought that injury to the cortex of the brain during labour is the most likely cause of the disease.

(2) *The acquired type* occasionally follows childish diseases (e.g. the specific fevers) when it may be due to an encephalitis. In later life it may be associated with disease of the brain or nervous system.

Distribution.

One limb only—monoplegia.

One upper and one lower limb—hemiplegia.

Both lower limbs only—paraplegia.

All four limbs—quadriplegia.

Symptoms and signs. The child may appear to be mentally retarded, with a vacant face and loud cry, and severe cases bitterly resent examination. In early life, it will be observed that the child is late in noticing his surroundings. He is slow in attempting to sit, to stand, to walk and talk, and indeed may never achieve these things if the lesion is very severe. Later intellectual enfeeblement may become more apparent, the child is difficult to manage and the gait, if attempted, will be obviously inco-ordinate. There may be stiffness of the whole limb or of muscle groups, and deformity may be present due to contracture

of spastic muscles. Any attempt to straighten the limb is resisted by muscle-spasm and if one succeeds in straightening it the spasm returns immediately it is released. The gait is characteristic and is often of the "scissors" variety one leg crossing over the other when the patient attempts to walk. When special movements are attempted all the affected muscles become spastic and the patient cannot use one set of muscles without another being stimulated, so that movements are inco-ordinate.



Fig 170
Spastic hemiplegia.

It may be helpful to compare this condition with poliomyelitis, in which the patient is unable to perform a movement because a group of muscles is paralysed. The spastic patient is unable to perform a movement, not because a group of muscles is paralysed but *because there is insufficient relaxation of opposing muscles*. For example the polio may not be able to extend the knee because of paralysis of the quadriceps; the spastic cannot extend it because there is insufficient relaxation of the hamstrings. In both conditions, a muscle which is not balanced by an opponent of equal strength will not only pull a limb into a deformed position, but will contract until the deformity becomes fixed.

Deformities. As the child grows, flexion contractures increase, the normal muscles atrophy and deformities become fixed. The limbs assume a characteristic position, as described below.

Upper limbs. The elbow is flexed the forearm pronated, the wrist is flexed, and the thumb may be adducted and pressed into the palm by the flexed fingers, so that when asked to

perform a movement the patient uncurls his hand finger by finger

Lower limbs. The hips are flexed adducted and internally rotated. The knees are flexed and the feet held in equino-varus.

The reflexes are exaggerated and facial tics are frequent Sensory disturbances are rare. There may be involuntary movements of athetoid type which greatly interfere with the function of the limb and which are very distressing to the patient and his relatives. The hips may be dislocated by the muscle-spasm, and the patient is sometimes incontinent. Severe cases may become extremely thin, though obesity in later life is not uncommon if there is great difficulty in getting about. Circulatory changes are nearly always present and the extremities become cold and blue. The speech may be affected, and there may be associated deafness, blindness, or difficulty in swallowing.

Mental changes vary between complete imbecility on the one hand to slight emotional instability on the other The degree of intelligence must not be underrated. Many of these patients are highly intelligent, and in most of them the mentality is normal, but the physical disablement does not allow of its development especially if the speech is affected. Improvement of the physical condition is always matched by corresponding improvement in the intellect *It is very important for the nurse to remember that in any event the patient is never so feeble minded as he may appear and to conduct herself accordingly*

Treatment. *The aim of treatment* is the improvement of function by correction of deformity and by physical and mental re-education of the patient.

A quiet life in the company of other children is the ideal background to treatment, and the patient must be included in the conversation lessons, games and other activities of his fellows. Patience perseverance and unfailing good humour on the part of the nurse is essential she has an important rôle in re-educating the patient in the ordinary acts of living, so that he may become independent of others. On admission, the patient is often dirty difficult and refractory The nurse will set herself out to win his confidence and to teach him obedience and self-control. Unless otherwise ill, the patient is not treated as a helpless individual, though this is often less disturbing to

ward routine than teaching him to do things for himself. The spastic patient must never be fed unless absolutely essential no matter how lengthy and messy a procedure this might be. As co-ordination improves, the patient is encouraged to undertake his own toilet and to take an interest in his treatment, even to the extent of learning to apply or remove splintage. On the other hand, the nurse must remember that these things will be learned only very slowly. The patient must never be frightened; spastic limbs must be handled gently, firmly and smoothly, never in an abrupt or jerky manner. Pressure-sores are very liable to occur because of the impaired nourishment and mobility of the limbs. These patients are very sensitive to cold and bear pain badly.

Conservative treatment consists of correction of deformity by splintage; meantime intensive re-education of the patient as a whole as well as of particular muscle-groups is carried out. Defective sight or hearing must be treated, and speech training is very valuable.

Splintage. This may be ordered for correction of deformity or as an aid to walking. It may be worn at night only, or be removed for periods during the day for re-education to be carried out. In any case it should never be so rigidly applied as to produce permanent stiffness of the joints, thereby defeating the whole object of the treatment, i.e. the improvement of function. In case such splintage should be ordered, its application and care is described.

Upper limbs. Deformity is first of all corrected by means of repeated plaster fixation. The limb is held by the surgeon in as much supination of forearm and dorsiflexion of wrist as can be obtained, and an above-elbow plaster applied. Successive plasters are thereafter applied, gaining more correction each time and the position held for six to eight weeks. Thereafter free use is encouraged, with particular attention to re-education of the supinators and extensors. A plaster night shell may be ordered, holding the forearm in supination, the wrist in dorsiflexion and the thumb in opposition.

Lower limbs. To correct adduction of the hip and flexion of the knee, Thomas' bed-splints with below knee extensions are applied and tied out to the sides of the bed to overcome the

adductor spasm. The splint is applied in the usual way: the *extensions tied and the knee is gently brought down on to the* splint and bandaged firmly. Bandages and extensions must be kept tight, so that correction is constantly maintained. Plaster shells may be used in conjunction with the bed-splint, to hold the *feet at a right-angle. All areas subjected to pressure (e.g.* the areas under the bed-splint ring) must be treated carefully from the moment splintage is applied, particularly if the patient is incontinent. Sedatives may be ordered for the relief of pain, and every effort should be made to make the patient comfortable. An air ring may be used, and the patient is most comfortable if his head and shoulders are raised on pillows. The heels must not press into the bed, and the weight of the bedclothes must be supported. Occasionally a double abduction frame may be ordered. (Chap. XI.)

Retentive splintage usually consists of two calipers combined with outside T-straps and posterior stops. One caliper should be a little longer than the other. In severe cases, a spinal support and even a collar may be necessary and an attempt may be made to teach the patient to balance on crutches which later may be exchanged for walking-sticks as co-ordination improves. Correct balance must always be taught before walking is attempted. Above-knee night shells may be worn, and these can be tied out to the sides of the bed to maintain abduction of the hips. In cases where equino-varus of the *feet is the main problem, double or inside below knee irons may be ordered with outside T-straps and posterior stops, and plaster shells* for night wear.

Physiotherapy. This plays a very important part in the treatment and the wholehearted co-operation of the physiotherapist is essential. Exercises should be simple and rhythmic and the patient must be taught to relax. Warm baths are very valuable. As improvement begins, simple games and exercises which require purposeful co-ordinated movements are introduced. Fatigue *must be avoided and several short sessions daily* are better than one which is prolonged until both the patient and the physiotherapist are tired and irritable.

Passive movements are never given as they cause severe pain and increase the spasm, though a joint may be coaxed into

a corrected position during treatment by the physiotherapist. A limb may be passively stretched for splintage to be applied, and retained in the desired position, but no intermittent stretch is ever put on a spastic muscle.

Operative treatment. Operations may be performed on the following structures —(1) Peripheral nerves. (2) Muscles or tendons.

(1) Operations on peripheral nerves. *Stoeffel's operation* In this operation, the nerve-supply to an individual muscle or group of muscles is cut off by section of appropriate nerves. After this, the limb is held in the corrected position and re-education is carried out *Obturator neurectomy* may be performed to overcome adductor spasm The patient is nursed, either on a frame or in two bed-splints, with the lower limbs in wide abduction for six to eight weeks. Skin-extensions are usually necessary Re-education is commenced as soon as possible and calipers may be ordered, with plaster shells for night wear

(2) Operations on muscles and tendons. *Division of the pronator radii teres* is followed by plaster fixation in full supination for six to eight weeks. *Tenotomy of the adductors* requires fixation in wide abduction by means of a frame or two bed-splints for six to eight weeks. *Tenotomy of the hamstrings* may be performed to overcome flexion of the knee. A bed-splint with skin-extensions is usually required post-operatively and a caliper may be ordered *Open elongation of the tendo-achilles* is followed by plaster fixation just below the right-angle for eight to sixteen weeks. A double iron with posterior stops may be ordered, and a plaster shell for night wear

Post-operative nursing care. The nurse must remember that even minor operations on spastic patients are always attended by a considerable amount of shock. The patient must be kept warm at all times and the extremities observed carefully for signs of circulatory interference Pressure sores must be guarded against and the position desired by the surgeon maintained continuously

In all cases, re-education is commenced as soon as possible and continued over a long period. Correction of deformity is

only a prelude to the *real* treatment, which is the physical and mental re-education of the patient.

After-care. On discharge, the patient or his relatives must understand the management of splintage, if worn. Suitable education and companionship is arranged, and as physical and mental re-education must be continued over a long period, the intelligent co-operation of a devoted mother is of inestimable value.

CHAPTER XXIV

INJURIES OF BONES AND JOINTS

Fractures. Predisposing causes of fracture. Exciting causes of fracture. Classification of fractures. Clinical diagnosis. Radiographic examination. Union of fractures. Factors which influence rate of union. The treatment of fractures. Principles of treatment. Reduction. Immobilisation. External splintage. Traction and counter traction. Extent of splintage. Internal splintage. Restoration of functional activity. Importance of the nurse's part in restoration of functional activity. Summary of treatment directed towards restoration of functional activity. The complications of fractures. Slow union. Non-union. Malunion. Adhesions and joint stiffness. Prevention. Exercises. Active use. Oedema in the later stages of treatment. Supporting bandages. Vascular complications. Volkmann's ischaemic contracture. Clinical features. Prevention. Treatment. Later treatment. Ischaemic contracture in the lower limb. Gangrene. Myositis ossificans. Treatment. Injuries to nerves. Injuries to vital organs. General complications.

A brief description of the commoner injuries of bones and joints is included in this book because the treatment of such lesions is an integral part of an orthopaedic service and cannot be regarded as a separate entity. The principles of treatment which have already been described in connection with other orthopaedic conditions also apply to the conditions discussed in the ensuing chapters. These include fractures, dislocations and injuries to soft tissues such as tendons and ligaments. The last named may be of equal or even greater importance than injuries of bone because in the absence of proper treatment the period of disability is likely to be prolonged.

With regard to nursing care in traumatic lesions, the reader will frequently find herself referred back to other chapters. This is to avoid wearisome repetition; for example the nursing care of a patient wearing a Thomas' bed-splint is described in detail in the chapter dealing with tuberculous of the knee joint. The reader is referred in particular to Chap. IV., which deals with plaster of paris technique.

FRACTURES

A fracture is a soluti[illegible] in con[illegible] [illegible] u ually as a result of external vi[illegible]

Predisposing causes of fracture include the following —

Age Children and old people are prone to fractures, the former because of their unsteady gait the latter because their bones are atrophic and brittle.

Sex Up to the age of fifty years, fractures are more frequently sustained by men than by women, because of the hazards of their occupations after the age of fifty years, they are more commonly sustained by women.

Pathological fractures may be due to the following conditions —

(a) Atrophy of bone as seen in the paralysed limb or in ankylosis of a joint

(b) Diseases of the nervous system such as poliomyelitis

(c) General bone diseases, such as Paget's disease rickets or osteogenesis imperfecta.

(d) Local bone diseases, such as tumours, cysts, or osteomyelitis.

Exciting causes of fracture. *Direct violence.* In this, the injuring force is applied directly to the bone and a fracture occurs at the site of impact A fracture of this type is usually transverse and is liable to be comminuted or compound.

Indirect violence The force is not applied directly to the bone but is transmitted along some other part of the body for example the clavicle may be fractured by a fall on the outstretched hand The fracture is usually oblique or spiral and is less likely to be comminuted or compound.

Muscular violence may be sufficient to produce a fracture, as when the patella is fractured by a violent contraction of the quadriceps in attempting to avoid a fall.

Classification of fractures. *A closed or simple fracture* is one in which the skin is unbroken and there is no communication between the fracture site and the external air

An open or compound fracture is one in which the skin or mucous membrane is ted to form a communication between the fracture site xternal air

A mplete fract in which the continuity of the t entirely l. The commonest example of t *eenstick fr* h occurs young subjects.

(F r

A complete fracture is one in which continuity of the bone is entirely interrupted. It is further described according to the direction of the line of fracture as explained below (Fig 171)

A transverse fracture is one directly across the bone. It is often due to direct violence

An oblique fracture is one in which the fracture line runs obliquely. It is due to indirect violence

A spiral fracture is one in which the fracture line runs in a spiral. It is due to indirect violence combined with torsional strain.

A longitudinal fracture splits the bone lengthwise.

T shaped and Y shaped fractures split the bone in the dir

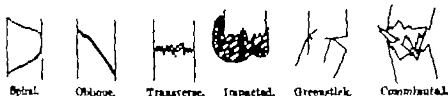


Fig 1 1
Types f fracture (A ylor)

ections signified by the letters. They are most commonly seen at the lower end of the humerus or femur

An abduction or adduction fracture is one in which the distal fragment is abducted or adducted in relation to the proximal fragments.

A comminuted fracture is one in which one or both fragments is broken into small pieces.

An impacted fracture is one in which one fragment is driven into the other and is thus stable as in a Colles fracture

A multiple fracture is one in which there is more than one separate fracture in the same bone.

A complicated fracture is one which involves some other organ, such as a nerve, blood vessel or underlying structures for example the bladder may be injured in fracture of the pelvis, or the lung in fracture of the ribs.

Fracture-separation of epiphyses occur in young subjects, when the bone gives way through the epiphyseal cartilage. A metaphyseal fragment is usually detached with the epiphysis.

The clinical diagnosis of fracture is based on the following findings —

(1) *The history of injury*

(2) *Signs of local trauma.* These may include pain tenderness, swelling bruising and blistering of the skin

(3) *Loss of function of the part*

(4) *Deformity* may or may not be present. It is caused by the direction of the violence, by the weight of the limb or by muscular contraction *Displacement of fragments* is described according to their position. There may be angulation, lateral displacement or longitudinal displacement (over riding) Rotational displacement may also be present.

(5) *Localised bone tenderness* This is important because it may be the only sign present—for example in fractures of the carpal scaphoid.

(6) *Soft tissue injuries* A fracture may be accompanied by damage to skin, to ligaments, blood vessels, nerves, or to underlying soft structures.

(7) *Unnatural mobility* is the abnormal movement at the fracture site which may be elicited by rough handling This may be accompanied by *crepitus* (grating sounds), and should not occur if the limb is held securely

Radiographic examination is carried out in every case of suspected fracture, as none of the above signs may be present. Antero-postero and lateral views of the part are required. An oblique view is necessary for the scaphoid, and may be repeated after an interval Radiographs with a joint in different positions may be ordered for example, in injuries to the ankle.

Union of fractures. Union of a fracture in the first instance is by granulation tissue. The haematoma between the bone ends is invaded by calcium salts and transformed into a form of immature bone called *callus.* Eventually the callus matures and becomes fully formed bone by the action of the bone cells. Irregular masses disappear and the bone regains its normal shape.

Factors which influence rate of union. (1) *Individual variations* are manifest in the rate of healing of bone as in

any other body tissue so that no arbitrary time limit can be laid down for the rate of healing of a fracture

(2) *The age of the patient* The younger the patient the more quickly the fracture unites, and vice versa.

(3) *The type of fracture* Oblique and spiral fractures unite more rapidly than transverse fractures. Impacted fractures unite more rapidly than those in which there is a wide gap between the bone ends.

(4) *The presence of infection* In infected fractures, union is retarded by the associated hyperaemia and decalcification of the bones.

(5) *The blood supply of the fragments* If both fragments have a good blood supply firm rapid union is expected. If one fragment is deprived of its blood supply union will be slow If both fragments are deprived of blood-supply union will be very slow

THE TREATMENT OF FRACTURES

Three main principles of the treatment of fractures are described:—

(1) *Reduction.*

(2) *Immobilisation*

(3) *Restoration of functional activity*

(1) **Reduction.** This consists of correction of deformity and restoration of anatomical relationships. It is achieved by the following means —

(a) *Manipulation* The fracture is reduced by deliberate manipulation by the surgeon's hands. Manual traction is often required. This is the method of reduction in the vast majority of fractures, and may be performed under general or local anaesthesia. It is usually performed forthwith unless there is severe shock, haemorrhage or gross swelling of the part even then manipulation is attempted as soon as possible because as time goes by reduction becomes increasingly difficult as the bone ends become adherent in a deformed position

(b) *Operative reduction* is employed if manipulative reduction has failed or is likely to fail or if re-displacement has occurred or is likely to occur

Check X-rays Reduction is confirmed by X rays, which

are repeated from time to time according to the surgeon's orders. In general some lateral displacement in the shaft of the long bones may be considered unimportant, provided that there is no over riding angulation, or rotation of the fragments

(2) **Immobilisation** is the means by which reduction is maintained. It must be adequate uninterrupted, and retained for a sufficient length of time to allow the fracture to unite. Immobilisation is provided by the following means —

(a) External splintage (b) Internal splintage.

(a) **External splintage.** *Plaster of paris* is used in a large number of cases. The application and care of plaster casts has already been described in Chap IV

Splints (Chap V) are of varying types and in many cases have been superseded by plaster casts. Wooden splints may be used in first aid, and metal back splints, club-foot shoes and cock-ups provide useful pre-operative fixation. Splints of the aeroplane type may be ordered for shoulder injuries and Thomas bed-splint is widely used in the treatment of injuries to the lower limb

Traction and counter traction is used in unstable fractures in which there is a tendency to over riding For example in oblique fractures of the femur the pull of powerful muscles on the upper and lower fragments must be resisted. A description of the various types of traction and counter traction will be found in Chap II

Extent of splintage Only essential joints are immobilised, but as a rule, the joints above and below the site of fracture must be immobilised Notable exceptions to this rule are two of the commonest fractures, i.e. a Colles fracture at the wrist and a Pott's fracture at the ankle.

(b) **Internal splintage** may consist of a bone graft, a screw a plate and screws, a Smith-Peterson pin, or a Kuntscher nail.

(3) **Restoration of functional activity** This means the restoration of full use of the limb. The most perfect union of a fracture in the most perfect position will not benefit the patient if he is afterwards unable to use the limb Treatment directed towards the restoration of functional activity is commenced as

are repeated from time to time according to the surgeon's orders. In general some lateral displacement in the shaft of the long bones may be *considered unimportant, provided that* there is no over riding angulation, or rotation of the fragments.

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(3) Vascular complications.
(4) Myositis ossificans.
(5) Injuries to nerves.
(6) Injuries to vital organs.
(7) General complications.

(1) **Slow union** is said to be present when the fracture does not unite within the expected time. *It may be due to the following* :—

(a) Incomplete reduction.
(b) Inadequate or interrupted immobilisation.
(c) Excessive traction.
(d) Loss of blood-supply to one or both fragments.
(e) Infection.
(f) Interposition of soft parts, for example muscle flaps.

In fractures in which slow union is inevitable, for example in fractures of the scaphoid with impairment of the blood-supply the surgeon will warn the patient to expect a long period of immobilisation. The nurse will refrain from making prophecies as to how long immobilisation will continue, however heartening they may be to the patient. The patient who has been told by a nurse that his fractured scaphoid will require only eight *weeks* immobilisation and finds his wrist still immobilised after eight *months* is apt to lose faith in the nurse.

The nurse should take special note of the words *inadequate or interrupted immobilisation*. In recent fractures, special care is needed in adjusting splintage and in bi-valving plasters. In lower limb fractures, the patient must not walk in a bi-valved plaster. *If he must be moved, he is lifted* on to a trolley, moving the body and the affected limb as one unit, avoiding the slightest unguarded movement. If a wheel chair is used, the limb is supported on a plank placed on the seat. *In no circumstances will the nurse remove a splint or plaster completely without permission from the surgeon.*

Non-union is said to be present when the bone ends are sclerotic, rounded off and the gap between them is filled by dense fibrous tissue. A *false joint* may be present at the fracture site. Non-union may be due to any of the aforementioned factors.

Treatment is operative and consists of freshening or drilling

of fractured bone surfaces, with or without a bone graft Immobilisation is then continued until union is sound.

Mal union is said to be present when the fracture has united in a deformed position. Operative treatment may be advised if the deformity interferes with the function of the limb

(2) **Adhesions and joint stiffness** may be due to the following —

(a) Failure to exercise joints not immobilised.

(b) Inactivity and disuse of joints once immobilisation has ceased.

(c) Allowing movements of damaged joints too early before torn tissues have healed.

(d) Passive stretching to a stiff joint.

Prevention of adhesions and joint stiffness. *Active exercises* Specific exercises will be enumerated in connection with individual fractures. They are usually supervised by a physiotherapist but their vital importance must be appreciated by the nurse She will report to the surgeon any patient who cannot or will not perform his exercises. Exercises not only prevent stiffness of the joints which are not immobilised, they actually help to prevent stiffness of the joint which is immobilised. The contraction and relaxation of the muscles maintains their tone and ensures a free blood supply to the healing bone

Active use As soon as possible active use of the limb is encouraged. This is important as the patient does not then forget how to use the limb In upper limb fractures, the hand is used for all ordinary purposes short of wetting the plaster In lower limb fractures, the surgeon will order a walking plaster as soon as possible The patient is taught a normal heel-and-toe gait and encouraged to follow his every-day pursuits. When splintage is discarded, exercises to restore full functional use of the joints which have been immobilised are introduced, and continued until recovery is complete

Passive stretching is forbidden Any necessary manipulation will be carried out by the surgeon. Nurses and others must resist the temptation to apply passive stretching to a joint at any stage during the treatment

Oedema of the extremities is not a contra-indication to

exercises. Rather it is an added indication. In addition to active exercises, the limb should be elevated, if necessary with the patient in recumbency

Oedema in the later stages of treatment As a rule oedema of the upper limb does not occur after removal of plaster provided that exercises and functional use have been conscientiously carried out. In the lower limb, however removal of the rigid support may cause oedema especially towards the end of the day This is very likely to occur in middle-aged and elderly patients in whom the tone of the muscles is insufficient to maintain the circulation against the force of gravity This oedema must be prevented by a supporting bandage which is applied immediately on removal of plaster If oedema is already present the limb must be elevated until it subsides.

Supporting bandages are applied from the web of the toes to just below the knee. There must be no gaps in the bandage, otherwise the tissues will bulge through the gaps when swelling occurs. It is also important that the foot is held at the right angle when the bandage is applied so that wrinkling in front of the ankle joint is avoided. An *elastoplast* bandage is frequently ordered It may be applied inside out if the skin is sensitive *Viscopaste* bandage is less irritating to the skin It must be covered with a gauze bandage before the stocking is put on. *Ichthyopaste* bandage is even less irritating but it has a disagreeable smell and requires to be soaked in water before application *Unna's paste* bandage is applied by melting down the paste, painting it on to the limb and covering the limb with a gauze bandage another layer of paste and another bandage completes the dressing If an above-knee plaster has been worn, a crêpe bandage is applied to the knee.

(3) **Vascular complications.** These include rupture of arteries, traumatic arterial spasm or traumatic aneurysm. Partial occlusion of the blood-supply to a limb causes ischaemia complete occlusion causes gangrene.

Volkmann's ischaemic contracture

This is a dreaded complication of injuries to the elbow and forearm It is most common in supracondylar fracture of the

humerus, dislocation of the elbow or fracture of the forearm in its upper one third. It is due to irritation or injury to the brachial artery in response to this irritation or injury there is reflex spasm, not only of the main artery but of the collateral vessels, so that the blood-supply to the muscles is severely diminished. Volkmann's ischaemic contracture may follow slight injuries as well as severe ones and may even be due to constriction by a bandage splint plaster or tourniquet or to compression of the artery by flexion of a swollen elbow For this reason, cases

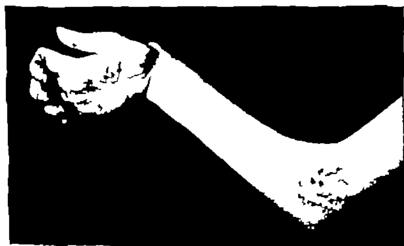


Fig 172.
A severe case of Volkmann's ischaemic contracture (*Watson Jones*)

of *injury to the elbow or forearm* are frequently detained in hospital for observation until it is certain that the circulation in the limb is unimpaired.

Clinical features The first sign of the onset of this condition is absence of the radial pulse. The surgeon will palpate the radial artery before splintage is applied thereafter it is palpated at ten minute intervals in cases in which it is not severed. The fingers are also inspected at ten minute intervals they become cold, swollen and either cyanosed or pale They are held in slight flexion and *cannot be completely extended.* Any attempt to straighten the fingers causes pain in front of the forearm. The patient may complain of severe burning pain

in the forearm and hand but the onset is often painless. If arterial spasm is not relieved within six or eight hours, the muscles die and become matted, fibrosed and contracted their power is then lost never to be completely regained. The nerves degenerate even if uninjured at the primary injury and the fingers become anaesthetic and fixed in a flexed position. Eventually the typical contractures occur the picture is one of a combined median and ulnar nerve palsy with hyperextension of the metacarpophalangeal joints, flexion of the interphalangeal joints, wasting of the intrinsics of the hand and of the muscles of the thenar and hypothenar eminences. This results in severe crippling of the limb (Fig. 172.)

Importance of immediate measures to prevent this complication

The importance of unceasing vigilance and frequent examination of the fingers after treatment for elbow or forearm injuries cannot be too heavily stressed. Do not attempt to heat the limb by applying hot water bottles or by placing the patient near a radiator or fire Elevate the limb, keep the patient warm, and *if any of the aforementioned signs are noticed inform the surgeon at once* **Delay is dangerous,** and may result in permanent crippling of the limb.

Treatment. (a) The front half of the plaster or the encircling bandage is removed.

(b) If the fracture is still unreduced further manipulation is performed.

(c) If the elbow has been flexed, the degree of flexion is reduced, if necessary to below the right-angle.

(d) If these measures fail to relieve the symptoms promptly spasm of the artery may be relieved by blocking the sympathetic nerve-supply to the limb by the injection of novocain. Alternatively operative exploration of the artery is performed. A damaged portion of the artery may be excised.

Later treatment. If the arterial spasm is relieved, and the symptoms disappear treatment proceeds as described for individual fractures. In established cases, later treatment is

aimed at improving the function of the limb by correction of deformity and re-education of such muscles as are spared.

Correction of deformity Flexion of the wrist is corrected first, either by successive plasters, gaining a little more correction each time or by wedging the plaster When about 30 or 40 dorsiflexion of the wrist has been obtained it is held on an anterior plaster slab, and the fingers are immobilised on wooden spatula splints until extension is obtained. Alternatively finger stalls attached to traction loops incorporated in a wrist plaster may be ordered.

Physiotherapy is ordered to restore as much muscle power as is possible and to minimise contracture Considerable im provement of function may take place over a long period.

Operative treatment In the late stages, operations on soft tissues, such as a muscle-slide of the forearm flexors, or lengthen ing of tendons in the lower forearm may be performed. Oper ations on bones include arthrodesis of the wrist or shortening of the forearm bones.

Ischaemic contracture in the lower limb. Damage to the femoral or popliteal artery in injuries of the lower limb may produce arterial spasm and partial occlusion of the blood supply The changes already described in connection with ischaemia in the upper limb occur with fibrosis of the muscles and rigid clawing of the toes. Anaesthesia of the foot may be very trouble some and give rise to ulceration of the skin.

Treatment proceeds on the same lines as described for ischaemia in the upper limb.

Gangrene due to total obliteration of the blood-supply is as a rule more likely to occur in the lower limb than ischaemia.

Treatment may consist of amputation of the limb In any case of incipient gangrene keep the patient as warm and com fortable as possible but do not attempt to heat the limb itself In fact the surgeon may give orders for it to be exposed to cold air or even encased in ice

(4) **Myositis ossificans.** Traumatic ossification occurs in injuries in which there is tearing of the periosteum from the bone by avulsion of soft tissue attachments There is a sub-

periosteal haematoma which may be disseminated into surrounding tissues. New bone is laid down in the haematoma so that bony masses are formed which may limit the movement of a joint. Traumatic myositis ossificans is most frequently seen after dislocation of the elbow in childhood, especially if reduction is delayed, or if passive stretching to the joint further tears the periosteum and disturbs and disseminates the haematoma. The ossification is first seen on radiographs as a shadow in the soft tissues in front of the joint which may then be converted into a block of bone.

Treatment. This complication is avoided by —

(a) Prompt reduction of the dislocated joint.

(b) Retaining immobility for sufficient time for the periosteum to become firmly adherent to bone and for soft tissue injuries to heal.

(c) Allowing the joint movement to recover by the patient's own active exercise, **not by passive stretching.**

Operative treatment. Excision of spurs or blocks of bone may be performed at a late stage of treatment.

(5) **Injuries to nerves** may occur at the time of accident or be a late sequel. Peripheral nerve lesions are described in *Chap. XXIX.*

(6) **Injuries to vital organs** may occur as a complication of fracture; for example, the bladder may be damaged in fracture of the pelvis.

(7) **General complications** include hypostatic pneumonia, renal calculi, bed sores, fat embolism, thrombosis and embolism. Hypostatic pneumonia occurs most commonly in elderly patients. It should be prevented by nursing the patient in the sitting position (when possible) or by frequent change of position in bed. Breathing exercises may be ordered. Renal calculi are also prevented by movement in bed and by the administration of copious fluids. Bed sores are prevented by change of position and by scrupulous care of the skin from the first moment. Fat embolism is thought to be due to the liberation of fat from the marrow cavity of a broken bone into the circulating blood stream. The fat embolus may settle in the lungs, causing respiratory symptoms, or in the brain, causing delirium, coma and

death. Thrombosis or embolism is prevented by movement in bed and by forbidding the use of pillows under the knees. Pain or swelling in the leg must be reported to the surgeon at once. Treatment consists of the administration of substances which retard the clotting of blood, such as Heparin. Such treatment is controlled by blood-coagulation tests.

CHAPTER XXV

INJURIES OF THE UPPER LIMB

The aim of treatment. Stiffness of the shoulder. Shoulder exercises. Injuries to the shoulder. Supraspinatus tendonitis. *Rupture of the supraspinatus tendon. Rupture of the biceps tendon.* Fracture of the clavicle. Treatment by figure-of-eight bandage. Three-handkerchief method. Dislocation of acromio-clavicular joint. *Treatment by Jones strapping. Fracture of the scapula.* Fracture of the great tuberosity of the humerus. Treatment. Fracture of the neck of the humerus. Treatment. Dislocation of the shoulder. *Treatment. Dislocation of the shoulder with fracture of the great tuberosity.* Fracture-dislocation of the shoulder. Recurrent dislocation of the shoulder. Tennis elbow. *Supra-condylar fracture of the humerus.* Treatment. Fracture of the head of the radius. Fracture of the olecranon. Displacement of the epiphysis of the external condyle of the humerus. *Displacement of the internal condyle of the humerus. Dislocation of the elbow.* Fracture-dislocation of the elbow. Fractures of the forearm. Complete fracture of shafts of radius and ulna. Monteggia *fracture. Fracture shaft of radius with inferior radio-ulnar dislocation.* Injuries to the wrist and hand. Sprain of the wrist. Traumatic teno-synovitis. Tendo-vaginitis stenosans. Colles *fracture.* Treatment. *Finger exercises. Shoulder exercises.* Rupture of the tendon of the extensor longus pollicis. Displacement of lower radial epiphysis. Fracture of the scaphoid. Treatment. *Dislocation of the lunate. Injuries to the fingers and hand.* Sprain of finger or thumb. Rupture of ligaments. Dislocation of a metacarpophalangeal joint. Bennett's *fracture-dislocation of the thumb. Fracture of the shaft of the metacarpal.* Fracture of the neck of the metacarpal. Fracture of proximal phalanges of the fingers. Mallet finger. Treatment in plaster. Sudeck's atrophy.

FRACTURES of the upper limb may be caused by direct violence or more frequently by indirect violence, such as a fall on the outstretched hand.

The aim of treatment in injuries to the upper limb is to restore movement of the joints, because this is essential to the function of the limb. Conversely, in the lower limb, stability rather than mobility of the joints is the chief functional demand. The treatment of fractures of the upper limb is therefore greatly influenced by the age of the patient. In middle-aged and elderly patients, the immobilisation necessary to ensure union in a perfect position would in many cases result in stiffness of the joints, so that the function of the limb as a whole would be seriously impaired.

It is for this reason that in older patients an imperfect anatomical reduction of a fracture may be accepted, provided that the function of the limb as a whole is regained For example in fractures of the clavicle in older patients, movements of the shoulder are commenced within a few days of injury so as to avoid stiffness of that joint whereas in young patients, movement is rapidly recovered despite several weeks enforced immobility

Stiffness of the shoulder is a complication of injuries to the upper limb It may be due to adhesions, which may form when movements of the shoulder are neglected during immobilisation of the elbow forearm or wrist or it may be due to peri arthritis.

Peri-arthritis is the name given to degeneration and inflammation of the capsule and soft tissues surrounding the shoulder It may occur spontaneously or after trivial injury especially in middle-aged patients. Movements are limited by pain and muscle-spasm, abduction and external rotation being especially limited. Widespread adhesions and gross limitation of movement gives rise to the term frozen shoulder

Treatment Rest in a sling is advised during the acute stage As this subsides, active exercises are gradually introduced, commencing in recumbency and progressing to full swinging movements. Constant encouragement and perseverance is essential *passive stretching is never employed.*

Shoulder exercises. The movement to be regained first is external rotation (1) The patient lies on his back with the elbows to the sides and the hands pointing towards the ceiling gradually turning the hands out until they touch the bed. (2) The hands are clasped behind the head and pressed back until the elbow touches the bed. (3) The shoulders are abducted to the right angle and the patient endeavours to touch the top of the bed with each hand. (4) The patient reaches over his head until he can touch the opposite ear The same movements are then performed as the patient stands with his back to the wall. He then progresses to creeping up the wall by *standing sideways to it and reaching higher and higher with the finger tips.* It is encouraging to mark the level reached each time Later internal rotation is regained by placing the hand behind

which is normally filled by the biceps and the belly of the muscle can be seen to be retracted on movement of the elbow and forearm.

Treatment consists of suture of the biceps tendon.

Fracture of the clavicle. The clavicle [illegible] fractured [illegible] middle third by a fall on the outstretched hand. There [illegible] and [illegible] displacement may be present.

Treatment. Reduction and [illegible] is achieved by figure-of-eight bandage.

Application of figure-of-eight bandage. Two large [illegible] wool and [illegible] two 3 [illegible] by [illegible] calico bandages are required. Wash and powder the axillae. The patient sits on a stool and the operator stands behind him with one [illegible] on the stool and the knee between the patient's shoulder blades (Fig. 177). Place the pads [illegible] in the axillae and start the bandage in [illegible] the sound shoulder carrying it across the back [illegible] the affected [illegible] the turns of bandage cross over the [illegible]. Each turn [illegible] bandage should draw the [illegible] and backward [illegible] the bandage must be firmly [illegible] the limb. The end of the bandage is firmly secured [illegible] and the arm is [illegible] in a [illegible]. Ex[illegible] the fingers [illegible] and [illegible] are [illegible]. If the arm and hand become [illegible] the [illegible] the bandage must be removed and reapplied [illegible].



Fig. 177.
[illegible] figure-of-eight bandage [illegible]

the back, reaching upwards towards the shoulder blades. Later still, swinging exercises are introduced.

Manipulation under anaesthesia may be performed when the *shoulder is no longer painful*, but the range of movement is not improving by the patient's own efforts. It is performed very gently and is followed by *active exercises only*. Passive movements are never given.

INJURIES TO THE SHOULDER

Supra spinatus tendonitis is due to degenerative changes in the tendon and in the *capsule of the shoulder joint*. It gives rise to no limitation of movement of the shoulder but there is an acute pain when the tendon impinges on the acromion process during the middle range of abduction of the shoulder, i.e. between 60–90 abduction. There may be calcification of the tendon.

Treatment consists of novocain infiltration followed by radiant heat and exercises. Excision of calcified material may be advised, or *excision of the outer margin of the acromion*.

Rupture of the supra spinatus tendon may be partial or complete. Partial rupture gives rise to symptoms similar to supra-spinatus tendonitis. Complete rupture of the supra spinatus results in loss of abduction of the shoulder as the humeral head is not then held in contact with the glenoid cavity to allow the deltoid to abduct the arm from the side.

Treatment. Partial rupture of the tendon may be treated by continuous rest in abduction on a Littler-Jones splint or in a plaster spica with removable lid. *The arm is never allowed to drop to the side*. Abduction exercises are commenced in two or three weeks, and the splint is discarded when the shoulder can be actively abducted well above the right-angle. Operative suture may be advised and it may be accompanied by excision of the acromion.

Rupture of the biceps tendon *may occur as a result of* degenerative changes in the tendon or in the capsule of the shoulder joint. It may occur spontaneously or as a result of muscular effort. There is a sharp pain in the shoulder which is accompanied by swelling: a hollow appears in the upper arm

of white adhesive felt is placed beneath the elbow and another over the outer end of the clavicle. The two pads are then pulled tightly together by several layers of strapping so that the humerus is pushed upwards and the clavicle downwards. (Fig. 175.) The strapping must be kept tight for about five weeks. Finger and wrist exercises are practised throughout. As the patient is generally young and athletic, movement of the shoulder joint is quickly recovered.

Operative treatment consists of fixation of the acromio-clavicular joint by wires or screws, or excision of the outer end of the clavicle.

Fracture of the scapula. Fracture of the body of the scapulae is due to a direct injury which may also cause fracture of the ribs, or to a fall on the shoulder or on the outstretched hand.



Fig. 175.
Jones' strapping for dislocation of acromio-clavicular joint.
(*From Jones*)

Treatment. In middle aged patients, firm strapping is applied over the affected shoulder from the clavicle to the opposite side of the chest, holding the scapulae to the chest wall. The arm is supported in a sling. Finger, wrist and elbow exercises are started at once. Displacement of the fragments is unimportant compared to the danger of stiffness of the shoulder and shoulder exercises are commenced in about ten days. In young subjects, the displacement is corrected by means of continuous skin traction with the shoulder abducted to the right angle.

Fracture of the great tuberosity of the humerus may occur as the result of a direct blow or as part of a dislocation of the shoulder. The tuberosity may be comminuted but not displaced, or there may be avulsion of the tuberosity with or without displacement. There is pain, swelling and bruising and tenderness referred to the great tuberosity. If the tuberosity has been

The bandage is usually re-applied every second or third day the axillae are washed and powdered at the same time. Middle-aged patients commence shoulder exercises after a few days, because of the danger of stiffness of the shoulder Younger patients may commence exercises in two weeks. The bandage is generally discarded after about three weeks.

Three-handkerchief method. Two tubular pieces of stockinette are stuffed with splint wool so as to form two thick sausages. These are placed round each shoulder and tied tightly together between the scapulae. (Fig. 174) The shoulders are pulled backwards in the same manner as in the figure-of-eight bandage. The sausages are tightened daily by refastening the ties between them.



Fig 174.
Three handkerchief method of treating fracture of clavicle.
(*Farquharson*)

Dislocation of the acromio-clavicular joint is an injury in which the ligaments of the acromio clavicular joint are partially or completely torn. There is swelling of the shoulder and pain is referred to the acromio-clavicular joint. In incomplete rupture of the ligaments, the only sign may be undue prominence of the clavicle, but if the rupture is complete the scapulae is pulled away from the clavicle by the weight of the arm, so that the acromion lies below and in front of the clavicle.

Treatment consists of elevating the whole arm and shoulder girdle and fixing it with adhesive strapping so that the acromion is pushed up towards the clavicle. This method of fixation was first described by Sir Robert Jones.

Method of application The axilla is washed and powdered, and protected with a small pad of wool. The arm is supported in a collar and cuff sling with the elbow at a right-angle. A pad

of white adhesive felt is placed beneath the elbow and another over the outer end of the clavicle The two pads are then pulled tightly together by several layers of strapping so that *the humerus is pushed upwards and the clavicle downwards.* (Fig. 175) The strapping must be kept tight for about five weeks. Finger and wrist exercises are practised throughout As the patient is generally young and athletic movement of the shoulder joint is quickly recovered.

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Fig 175.
Jones strapping for dislocation of acromio clavicular joint. (Watson Jones)

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Fracture of the great tuberosity of the humerus may occur as the result of a direct blow or as part of a dislocation of the shoulder The tuberosity may be comminuted but not displaced or there may be avulsion of the tuberosity with or without displacement. There is pain, swelling and bruising and tenderness referred to the great tuberosity If the tuberosity has been

avulsed, there is loss of abduction as described for rupture of the supraspinatus tendon.

Treatment In fractures without displacement the arm is supported in a sling and exercises are commenced in a day or so *and practised regularly The sling is discarded in about a* fortnight and full active use of the arm is encouraged. Fractures with displacement require fixation in an abduction splint or plaster spica with removable lid. The arm is abducted, externally rotated and forwardly flexed, so that the avulsed fragment is approximated to the bed from which it is torn. *The arm is never lowered until union is sound.* Finger wrist and elbow exercises are begun at once and shoulder exercises are begun in six or eight weeks. The plaster or splint is not discarded until the patient can actively abduct the arm above the right-angle. Full movements are eventually restored by active exercises.

Fracture of the neck of the humerus may be due to a direct blow on the shoulder or due to a fall on the outstretched hand This causes either an adduction or abduction fracture of the neck of the humerus.

Treatment A simple crack fracture without displacement is treated by early active exercises to avoid stiffness Immobilisation is unnecessary Impacted fractures in elderly patients are treated by early active movements. In young patients, adduction fractures are treated by traction and fixation in ab*duction for about four weeks, followed by active exercises.* Abduction fractures, on the other hand, are treated by a sling, and shoulder movements are commenced in about fourteen days. Impacted fracture-dislocations of severe type may cause complete disorganisation of the shoulder joint Elderly patients are treated by the application of an axillary pad or wedge supporting the arm in 30 abduction. Shoulder exercises are commenced in about four weeks. In young patients operative reduction may be advised. Sometimes avascular necrosis of the humeral head supervenes and an arthrodesis of the shoulder is the ultimate fate

Dislocation of the shoulder joint may occur as a result of a fall which forces the shoulder into extreme abduction The dislocated humeral head is usually displaced anteriorly and lies

avulsed, there is loss of abduction as described for rupture of the supraspinatus tendon.

Treatment In fractures without displacement the arm is supported in a sling and exercises are commenced in a day or so and practised regularly The sling is discarded in about a fortnight and full active use of the arm is encouraged. Fractures with displacement require fixation in an abduction splint or plaster spica with removable lid. The arm is abducted, externally rotated and forwardly flexed so that the avulsed fragment is approximated to the bed from which it is torn. *The arm is never lowered until union is sound* Finger wrist and elbow exercises are begun at once and shoulder exercises are begun in six or eight weeks. The plaster or splint is not discarded until the patient can actively abduct the arm above the right-angle Full movements are eventually restored by active exercises.

Fracture of the neck of the humerus may be due to a direct blow on the shoulder or due to a fall on the outstretched hand. This causes either an adduction or abduction fracture of the neck of the humerus.

Treatment A simple crack fracture without displacement is treated by early active exercises to avoid stiffness Immobilisation is unnecessary Impacted fractures in elderly patients are treated by early active movements. In young patients, adduction fractures are treated by traction and fixation in abduction for about four weeks, followed by active exercises. Abduction fractures, on the other hand, are treated by a sling and shoulder movements are commenced in about fourteen days. Impacted fracture-dislocations of severe type may cause complete disorganisation of the shoulder joint Elderly patients are treated by the application of an axillary pad or wedge supporting the arm in 30 abduction. Shoulder exercises are commenced in about four weeks. In young patients operative reduction may be advised Sometimes avascular necrosis of the humeral head supervenes and an arthrodesis of the shoulder is the ultimate fate

Dislocation of the shoulder joint may occur as a result of a fall which forces the shoulder into extreme abduction. The dislocated humeral head is usually displaced anteriorly and lies

beneath the coracoid process (subcoracoid dislocation), and in extreme cases may lie below the clavicle There is pain in the shoulder and all movements are limited. There is loss of the normal rounded contour of the shoulder and the elbow cannot be brought to the side *Dislocation of the shoulder is not infrequently complicated by injury to the branches of the brachial plexus. Every patient is specially examined with this complication in view* The circumflex nerve is most commonly involved so that the deltoid is paralysed and the power of active abduction is lost Sometimes the displaced head of the humerus presses on the axillary vessels.

Treatment The dislocation is reduced by manipulation with or without anaesthesia.

Kocher's manipulation The patient lies on a couch and the surgeon stands at his side Traction is applied and the arm is very gently and smoothly manipulated first into external rotation, then brought forward across the chest and finally into internal rotation.

Hippocratic manipulation The patient lies on a couch and the surgeon grasps the wrist with both hands. He places his unbooted foot close to the axilla between the arm and the chest wall. He then leans back and exerts firm steady traction and the head of the humerus is levered outwards over his foot and slides back to the glenoid cavity The patient is then asked to abduct the arm in order to ascertain that there is no rupture of the supra-spinatus tendon. If this is so the shoulder is immobilised in abduction and external rotation as already described Otherwise a fairly large pad of wool is placed in the axilla, the arm is supported in a collar and cuff and then bandaged to the trunk The fingers and wrist are left free and exercises for these joints are commenced at once The bandage and sling is discarded in about three weeks and active exercises are commenced.

Dislocation of the shoulder with fracture of the great tuberosity requires the same treatment unless there is retraction of the fragment by the supraspinatus muscle when it will be necessary to immobilise the shoulder in abduction external rotation and forward flexion as already described.

Fracture dislocation of the shoulder This is a severe

avulsed, there is loss of abduction as described for rupture of the supraspinatus tendon.

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Dislocation of the shoulder with fracture of the great tuberosity requires the same treatment unless there is retraction of the fragment by the supraspinatus muscle when it will be necessary to immobilise the shoulder in abduction, external rotation and forward flexion as already described.

Fracture dislocation of the shoulder. This is a severe

injury combining a subcoracoid dislocation with fracture of the neck of the humerus. In severe cases the humeral head may be upside down.

Treatment is by manipulative reduction, traction being applied either with the arm to the side as in the Hippocratic manipulation, or by the Robert Jones method when the arm is held in right-angled or hyper-abduction.

Operative reduction may be advised. Avascular necrosis of the humeral head may necessitate arthrodesis of the shoulder

Recurrent dislocation of the shoulder is a condition in which there is repeated dislocation of the shoulder from trivial violence It usually occurs in young subjects, particularly in athletes and epileptics.



Fig 176.
U shaped slab applied for fracture of the humerus. The encircling bandage and supporting sling has been omitted.
(F [illegible])

Treatment Many different operations have been employed for this condition. Bankart s operation consists of a repair of the glenoid fibro-cartilage In Nicola s operation, the long head of the biceps is passed through a drill hole in the head of the humerus and then sutured to itself

Fracture of the shaft of humerus. Fracture of the shaft of the humerus does not produce overriding such as occurs in the femur because the muscles of the arm are not so powerful as in the leg, and their retraction is prevented by the weight of the limb. Displacement is easily corrected by manipulation and continuous traction is seldom used.

Treatment Spiral fractures are generally immobilised by a gutter-splint and collar and cuff sling or by applying a U shaped slab extending from the axilla, down the inner side of the arm, round the elbow and up the outer side to the shoulder (Fig 176) This is bandaged in position and the arm supported in a sling. Fingers and wrist exercises are begun at once and gentle shoulder exercises in a few days.

Horizontal fractures usually unite more slowly and greater immobility is necessary A plaster spica may be ordered, and the arm is usually held in abduction and forward flexion so that the patient's hand is almost in front of his mouth.

Fractures of the mid shaft of the humerus may be complicated by musculo-spiral palsy (Chap XXIX.)



Fig 177
Collar and cuff. The slings round the neck and wrist are joined by a third piece of bandage
(*Watson Jones*)

INJURIES TO THE ELBOW AND FOREARM

Traumatic synovitis of the elbow may follow a strain, especially in children. There is swelling tenderness over the joint and movements are limited by pain and muscle-spasm.

Treatment A collar-and-cuff sling is worn for two weeks. (Fig 177) Movement of the joint is allowed to recover at its own rate efforts to hasten it by massage passive stretching, or even *forced* exercises, will be met by increasing stiffness If these measures are avoided, recovery is generally complete within two months.

Tennis elbow Tennis elbow is characterised by pain over the outer side of the joint just below the external condyle. It occurs in persons whose work or recreations involve frequent

pronation-supination movement of the almost fully extended elbow. It is generally attributed to incomplete rupture of the fibres of the common extensor tendon. There is pain referred down the back of the forearm which is sometimes so severe as to prevent the patient turning objects such as taps or door handles.

Treatment. Conservative treatment consists of local strapping, local injections of novocain, physiotherapy or rest in a cock-up splint. Manipulation under anaesthesia may be advised, followed by active exercises. Manipulations without anaesthesia may be repeated at intervals.

Operative treatment consists of dissection or division of the common extensor tendon.

Supracondylar fracture of the humerus is a common elbow injury in childhood and adolescence. In the great majority the lower humeral fragment is displaced backwards. In a more rare type, it is displaced forwards.

Treatment. *Reduction is obtained by traction and manipulation.* In the common type of fracture with backward displacement of the fragment the elbow is fixed in flexion by a wide posterior slab, which is lightly encircled with a gauze bandage. The limb is then supported in a collar and cuff. The more rare type of forward displacement requires fixation in full extension. Before the plaster slab is applied, the circulation is noted by feeling the radial pulse and by testing the circulation by compression of the finger tips. If there is gross swelling the elbow must not be so flexed as to compress the vessels in front of the elbow because of the danger of Volkmann's ischaemic contracture. (Chap. XXIV.) Flexion may be increased later when the swelling subsides, and the plaster slab converted into a full plaster. This is generally retained for about three weeks, thereafter a sling is worn for about a week and active exercises are commenced.

Passive stretching is forbidden. The elbow is particularly *susceptible to trauma from repeated passive stretching.*

Movement is recovered by the patient's own active exercises and by no other means. The patient himself and his relatives must be warned that it is not only useless but actually harmful to try to hasten matters by carrying heavy weights

with the object of straightening the elbow Nurses, physiotherapists and others must in no circumstances attempt to straighten it

Complications are Volkmann's ischaemic contracture myositis ossificans, and lesions of the ulnar median or musculospiral nerves.

Fracture of the head of the radius is generally due to a fall on the outstretched hand. Pain in the elbow is aggravated by pronation-supination movements, there is limitation of extension, effusion into the joint, and local tenderness over the head of the radius.

Treatment Crack fractures without displacement are treated by supporting the arm in a comfortable degree of flexion in a collar and cuff. Finger wrist and shoulder exercises are begun at once and cautious elbow movements in a day or two Marginal fractures with displacement and comminuted fractures of the whole head are treated by excision of the head of the radius, performed within seven to ten days of injury

Fracture of the olecranon may be due to direct violence or to muscular violence when the olecranon is avulsed by the triceps.

Treatment If there is no displacement fixation in plaster from the shoulder to the wrist with the elbow in right-angled flexion is generally advised.

In fractures with displacement operative reduction and suture of the fragment may be performed, followed by fixation in full extension until union is firm a collar and cuff is then worn, and active exercises commenced.

An alternative method of treatment which is used in older patients consists of excision of the fragment of the olecranon and suture of the triceps. Immobilisation in a plaster slab is maintained for about three weeks, followed by active exercises.

Displacement of the epiphysis of the external condyle of the humerus is sustained in childhood. It is treated by manipulative reduction and immobilisation in a posterior plaster slab and collar and cuff. Operative reduction may be performed. Failure of reduction may cause cubitus valgus (Fig 178) This may be corrected by osteotomy Ulnar nerve palsy may

by passing a calico bandage or piece of ticking over a pad of wool in front of the arm just above the elbow This is held by an assistant or fastened to a stationary object, such as an upright post. (Fig 180) Traction is then applied to the hand, continued until reduction is secured, and maintained whilst a posterior slab is applied. When this has set, the calico sling is cut and the slab is covered by turns of plaster bandage If angulation is imperfectly corrected, an attempt may be made to



Fig 179.
Above-elbow plaster applied for fracture of both bones of forearm. The patient is practising shoulder exercises. (*Watson Jones*)

obtain further correction by wedging the plaster A plaster loop may be incorporated in the cast at the level of the fracture the cast is then suspended by this loop in a collar and cuff. Otherwise it is supported in a sling or collar and cuff in the ordinary manner

The plaster must not become loose fractures of this type are prone to re-displacement a new plaster is applied as soon as the swelling has subsided, and changed as often as is necessary It must always include the elbow joint.

Operative reduction may be performed. A bone-graft or transfixion screw is used if reduction is unstable

Monteggia fracture. A Monteggia fracture is a fracture of the upper shaft of the ulna with dislocation of the head of the radius.

Treatment Manipulative reduction may succeed, but open reduction and internal fixation of the ulna is generally necessary Bone-grafts may later be performed in cases of non-union.

Fracture shaft of radius with inferior radio-ulnar dislocation. Fracture of the radial shaft in its middle and lower



Fig 180.
Reduction and immobilisation of fracture of both forearm bones by traction against a calico sling. The sling is cut when the plaster is hard. (*Watson Jones*)

thirds is usually accompanied by dislocation of the lower end of the ulna. The triangular fibro-cartilage and the tip of the ulnar styloid process is avulsed, and the ligaments of the inferior radio-ulnar joint are torn.

Treatment Manipulative reduction, with counter traction by a calico sling and strong traction in the line of the thumb is followed by plaster fixation from the upper arm to the meta carpal heads. The elbow is flexed to the right-angle the fore-arm is held in mid position and the hand is held in full ulnar deviation. The plaster is closely moulded round the radial

side of the wrist. Re-displacement readily occurs and sometimes necessitates continuous thumb traction. A wire hook is incorporated in the plaster ribbon gauze is then soaked in collodion, rolled round the thumb and extension tapes are fastened to the hook, as shown in Fig 184

Operative treatment consists of skeletal transfixion or fixation with a transfixion screw or a plate and screws.

Unreduced cases may be treated by excision of the lower end of the ulna.

INJURIES TO THE WRIST AND HAND

Sprain of the wrist gives rise to pain swelling and loss of function of the hand. If this is not quickly relieved by the application of strapping or a cock up splint further investigation is required in order to eliminate more serious conditions, for example a fracture of the scaphoid.

Traumatic tenosynovitis occurs in the tendon sheaths around the wrist especially in those of the long extensors of the thumb. It is often the result of repetitive movements, and is *common amongst industrial workers. There is* aching pain, swelling, and creaking sounds on movements of the thumb.

Treatment consists of immobilisation of the thumb and wrist on an anterior plaster slab this is followed by simple strapping and use of the hand is gradually resumed. Physiotherapy may be advised in chronic cases.

Tenovaginitis stenosans is due to fibrous constriction of the sheaths of the short extensor and the abductor of the thumb. There is pain centred over the radial styloid, which is exaggerated by adduction of the thumb Palpation of the wrist may reveal a small nodule over the radial styloid process.

Treatment consists of excision of the fibrous material.

Colles' fracture of the radius. Colles fracture is a fracture of the lower end of the radius within 1 in. of the wrist joint. The lower fragment is displaced backwards and tilted to the radial side there is impaction and, sometimes, comminution of fragments and involvement of the articular surface. Colles fracture is common in *elderly women due to a fall on the outstretched hand* The backward displacement and tilting of the

lower fragment gives rise to the typical "dinner fork" deformity There is a definite "step" between the dorsum of the wrist and hand, which is carried to the radial side (Fig 181)

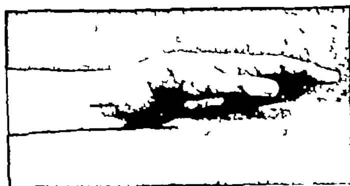


Fig. 181.
"Dinner fork" deformity in Colles' fracture of the radius.
(Watson Jones)



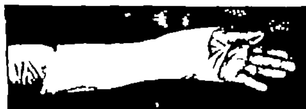


Fig 182.
Plaster cast for Colles' fracture. (Watson Jones)

Treatment is by manipulative reduction. The fragments are disimpacted by strong traction applied to the fingers and thumb and the displacement is corrected by direct pressure over the fragments. An unpadded plaster is then applied, extending from the metacarpal heads to just below the elbow and closely moulded over the radial side of the first metacarpal to the base

of the thenar eminence. As the plaster sets, it is moulded by the surgeon so that the carpus and the lower fragment of the radius are pushed inwards and forwards. A thin strip of bandage is taken across the palm of the hand. It must extend over the horizontal creases *and must not prevent full flexion of the metacarpo-phalangeal joints.* (Fig. 182.)

Finger, elbow and shoulder exercises are commenced *at once.* Delay may result in permanent joint stiffness. A sling is allowed for the first day or two, until swelling has subsided, but it is removed at frequent intervals for shoulder exercises. The hand must not be tucked inside the coat. If swelling is very severe, the patient may remain recumbent with the limb elevated on pillows so that the fingers point towards the ceiling. It may even be necessary to split the plaster down to the skin from the palm to the elbow.

Finger exercises. The more swollen the fingers, the greater the need for finger exercises; no excuse is accepted for their non-performance. The thumb must also be exercised and must be kept out of the way during finger exercises.

(1) The fingers are fully extended and spread into abduction. (2) The fingers are flexed by touching the palm with the finger tips. (3) The metacarpo-phalangeal joints are flexed by attempting to touch the front of the wrist. (4) The patient attempts to approximate the tip of the thumb to each finger in turn.

Shoulder exercises. These are especially important in elderly patients; the shoulder is often jarred at the moment of injury and unless movements are begun at once and practised assiduously a "frozen shoulder" may result.

(1) The arm is abducted so that the plaster touches the side of the head. (2) It is externally rotated so that the hand is behind the neck. (3) It is internally rotated and placed behind the back so that the fingers point to the mid-scapular region. As soon as the sling is discarded, the hand is used for all ordinary duties, short of wetting the plaster.

The plaster is retained for about five weeks or until union is sound. An elastoplast or viscopaste bandage is occasionally ordered for a weel [illegible] two to [illegible] swelling, and wrist exercises and full [illegible] use [illegible] ed.

Fracture of the radial styloid process may be due to a back fire or to a fall on the outstretched hand.

Treatment is similar to that of a Colles fracture

Rupture of the tendon of the extensor longus pollicis may occur in injuries to the wrist joint It is subjected to friction as it passes over the radial styloid process and becomes so frayed that it ruptures, sometimes weeks after the original injury

Treatment consists of a transplantation of the distal end of the tendon into another tendon of the thumb.

Displacement of the lower radial epiphysis is an injury of childhood, as a result of a fall on the outstretched hand The lower radial epiphysis is displaced backwards, or backwards and outwards. Crushing of the epiphysis may cause premature fusion.

Treatment consists of manipulative reduction and plaster fixation as for Colles fracture

Fracture of the scaphoid. Fracture of the scaphoid may be due to a fall on the outstretched hand or to a back fire injury Movements of the wrist are limited and painful, there is swelling of the hand, and tenderness on pressure in the anatomical snuff box. X rays are taken in three planes, antero-posterior lateral and oblique The last named is often the only one to reveal the fracture Many cases are diagnosed and treated on clinical grounds alone as the fracture may not be obvious in X ray films until two or three weeks after the original injury

Treatment consists of immobilisation in an unpadded plaster cast *until union is sound* This period will vary from ten weeks to ten months. The length of time depends upon the degree of immobility and the blood-supply to the bone The plaster must extend from just below the elbow to the metacarpal heads it must include the first metacarpal and the thenar eminence, and is closely moulded into the palm as far as the transverse creases. The wrist is held in 30 dorsiflexion. (Fig 163.) Finger and shoulder exercises are commenced at once *the plaster is renewed at once should it become loose cracked or damaged in any way* As the period of immobilisation is long the patient is generally advised to return to light work.

Operative treatment In fractures of the waist and prox

imal pole of the scaphoid, the blood-supply to one fragment is cut off and aseptic necrosis supervenes. These cases may be treated by excision of the dead fragment.

Established non union of the scaphoid is treated by drilling or by bone-grafting. In cases in which arthritis of the wrist has developed, arthrodesis may be advised.



Fig 183.
Plaster casts for bilateral fracture of the scaphoids.
(*Watson Jones*)

Dislocation of the lunate may be due to a fall on the dorsi flexed hand. The flexor tendons are compressed by the dislocated bone, the fingers are stiff in semi flexion, and the wrist is stiff swollen and painful there is commonly a median palsy

Treatment consists of manipulative reduction and plaster fixation with the wrist in dorsiflexion the degree of dorsiflexion is later reduced. If this fails, reduction by skeletal traction or operative excision of the bone may be advised.

INJURIES OF THE FINGERS AND THUMB

The function of the fingers and thumb is of such vital importance that no injury to the hand should be regarded as trivial. Injured fingers are immobilised in the position of flex

ion unmjured fingers are left free and actively exercised from the moment of injury passive stretching of the fingers either by the patient or his friends is strictly forbidden.

Sprains of the finger or thumb are treated by the application of strapping for a week or two. Active use is encouraged but passive stretching is not allowed.

Rupture of the ligaments of the finger or thumb is treated by plaster fixation for about three weeks. Operative treatment may be necessary The rate of recovery in ligamentous injuries is often very slow

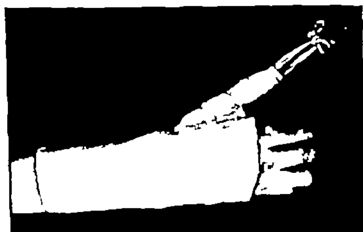


Fig. 184.
Plaster cast with continuous skin traction for Bennett's fracture-dislocation of the thumb. (*Watson Jones*)

Dislocation of the metacarpo-phalangeal joints of the finger or thumb is treated by manipulative reduction and plaster fixation in a moderate degree of flexion for about three weeks Open reduction is sometimes necessary

Bennett's fracture-dislocation of the thumb. This injury is usually due to a fall or to a blow on the radial side of the hand which forces the thumb across the palm. The fracture involves the carpo-metacarpal joint the metacarpal slides down the saddle shaped trapezium and reduction is difficult to maintain.

Treatment The fracture-dislocation is reduced by manual traction on the thumb an unpadded plaster is applied from

just below the elbow to the knuckles, including the thumb metacarpal and the thenar eminence and extending to the transverse crease in the palm. Before it has set a wire extension hook is incorporated in the plaster The middle and terminal phalanges of the thumb are then painted with collodion two strips of tape are placed on either side and covered with ribbon gauze which has been dipped in collodion. When the extension has set, the tapes are tied to the extension hooks. (Fig 184.) Pulp traction is sometimes advised. Traction is maintained for about four weeks. The fingers, elbow and shoulder are exercised

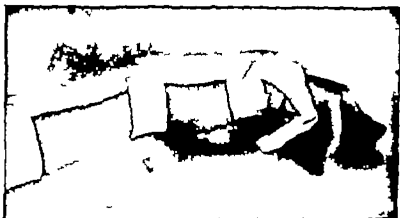


Fig 185.
Plaster cast for fracture of neck of fifth metacarpal. (Watson Jones)

throughout Plaster fixation without traction is usually continued for a further week or two or until union is sound.

Fracture dislocations of the finger are treated on the same lines as described for fracture dislocations of the thumb.

Fracture of the shaft of the metacarpal. Spiral fractures of the metacarpals may be due to a fall on the hand. Displacement is not gross and treatment is by plaster fixation for about four weeks in a posterior plaster slab or complete plaster

Transverse fractures of the shaft are usually due to a direct injury and generally occur in the first or fifth metacarpal. Overriding of the fragments is corrected by manipulation If

this fails, open reduction and internal fixation by a bone-peg may be performed.

Fracture of the neck of the metacarpal is generally due to direct violence There is tilting of the metacarpal head towards the palm, and backward angulation at the fracture site

Treatment is by manipulative reduction. A small strip of thin felt is placed over the finger and a plaster slab is applied with the metacarpo-phalangeal and interphalangeal joints flexed to a right-angle The slab is reinforced over the dorsum of the hand and strapped in position. (Fig 185) Exercises for all other fingers are commenced at once and immobilisation is continued for about three weeks.

Fractures of the proximal phalanges of the fingers are generally due to direct injury or to a fall with the finger flexed beneath the body The majority of fractures are found in the proximal part of the first phalanx, and angulation is produced by the pull of the lumbricals and interossei, which flex the proximal phalanx and extend the distal. The distal fragment is brought into alignment with the proximal by flexion of the finger

Treatment is by manipulative reduction and plaster fixation with the metacarpo-phalangeal joint flexed 45 and the proximal inter phalangeal joint flexed 90 A plaster slab is applied to the dorsal surface of the finger and must extend to the elbow As the finger is flexed, it must lie in its normal relationship to the palm of the hand. Only in the middle finger is the angle of flexion parallel with the long axis of the limb. The index, fourth and fifth fingers converge together in flexion to point towards the scaphoid, so that they are immobilised in this position. Exercises to the unaffected fingers are practised throughout the period of fixation, which is generally three weeks.

Mallet finger is due to an avulsion of the extensor tendon from its attachment into the base of the terminal phalanx. It is usually due to forcible flexion of the finger while the tendon is actively contracting, as when the finger is stubbed against an object The power of active extension of the terminal joint of the finger is lost though passive extension is normal. Un opposed pull of the long flexor tendon produces the typical

mallet deformity—flexion of the terminal interphalangeal joint with hyperextension of the distal—the terminal inter phalangeal joint cannot be fully extended and the distal inter phalangeal joint cannot be fully flexed.

Treatment consists of the application of a plaster cast holding the terminal interphalangeal joint in hyperextension and the proximal interphalangeal point in flexion.

Method of application A Gypsona bandage is cut to make a little slab six or seven layers thick. Before soaking it is tried



Fig 186.
Application of plaster cast for mallet finger The pressure on the finger is not released until the plaster has set firmly (*Watson Jones*)

on the finger so as to ensure an accurate fit. It must be long enough to extend from the base of the first phalanx to the tip of the third, and wide enough to extend up the sides of the finger It is then soaked and applied the finger being held in the corrected position until it has firmly set. The terminal inter phalangeal joint is held in hyperextension between the thumb and finger of one hand while the distal interphalangeal is flexed almost to the right-angle by the pressure of the fingers of the other hand. (Fig 186.) The pressure is not released until the plaster has set firmly Alternatively the patient is instructed to press the tip of the injured finger against the tip of the thumb or against the table and hold it in the desired position while

the plaster is applied. The plaster is worn for six or eight weeks or until recovery takes place

Sudeck's atrophy Sudeck's post traumatic acute bone atrophy may follow injuries to the wrist fingers or hand it is rarely seen in the foot. It is thought to be of nervous origin, but the changes which occur in the limb are typical of those which are due to neglect of exercise during immobilisation. There is persistent pain and loss of function of the limb and the fingers are stiff swollen and shiny X rays show extreme decalcification of the bones.

Treatment Pain and swelling of the fingers which persists within a few days of injury must be reported to the surgeon at once particularly if the overlying skin is shiny The patient is kept recumbent with the limb elevated, and active exercises at hourly intervals are insisted upon. It may be necessary to change the plaster

CHAPTER XXVI

INJURIES OF THE LOWER LIMB

Traumatic dislocation of the hip. Clinical features. Treatment. Fractures of the femur. Fracture of the neck of the femur. Types of fracture. Treatment of intracapsular fracture. Internal fixation by Smith-Petersen nail. Post-operative treatment. Nursing care. Treatment of extra capsular fractures. Hamilton Russell traction. Nursing care. Well leg traction. Nursing care. Fracture of the shaft of the femur. Subtrochanteric fracture of the femur. Treatment. Fracture of mid-shaft of femur. Treatment. Fixed traction in Thomas bedsplint. Reduction of fracture and application of splint. Balanced skin traction. Nursing care. Skeletal pin and balanced traction. Application. Nursing care. Later treatment. Open reduction and internal fixation. Supra-condylar fracture of the femur. Treatment. Injuries to the knee. Quadriceps drill. Traumatic synovitis. Recurrent synovitis. Traumatic haemarthrosis. Injuries of the collateral ligaments. Rupture of the internal lateral ligament. Rupture of internal lateral ligament. Rupture of the cruciate ligaments. Dislocation of the knee. Injuries to the semilunar cartilages. Tear of internal semilunar cartilage. Clinical features. Treatment. Preparation fo operation. Post-operative treatment. Application of Jones pressure bandage. Exercises. Tear of external semilunar cartilage. Cyst of the external semilunar cartilage. Loose bodies in the knee-joint. Rupture of the quadriceps. Fracture of the patella. Dislocation of the patella. Recurrent dislocation of patella. Fracture of the external condyle of the tibia. Fractures of the tibia and fibula. Fracture of shaft of tibia and fibula. Treatment by manipulation and plaster fixation. Skeletal traction. Correction of deformity by wedging the plaster. Later treatment. Operative reduction and internal fixation. Fracture of shaft of fibula. Injuries of the ankle and foot. Sprain of the ankle. Treatment. Dislocation of the ankle. Treatment. Recurrent dislocation of the ankle. Pott's fracture. Treatment. Later treatment. Displacement of lower tibial epiphysis. Fractures of the bones of the foot. Fracture of the calcaneum. Treatment. Fractures and dislocation of the talus. Treatment. Fracture of shaft of metatarsal. March fracture. Fracture of the neck of the metatarsal. Fracture of the toes. Comminuted fracture of the phalanges of the great toe.

Traumatic dislocation of the hip-joint. This injury is usually the result of a powerful thrust applied in the long axis of the thigh, so that the head of the femur is forced out of the acetabulum. It is often referred to as "the dashboard dislocation," because it occurs in head-on motor collisions, when the knee is forcibly struck by the dashboard. It may be accompanied by a fracture of the margin of the acetabulum. The

femoral head may be displaced either behind or in front of the acetabulum. In a more rare type of dislocation the head of the femur is forced through the floor of the acetabulum.

Clinical features. Traumatic dislocation of the hip-joint is a severe injury accompanied by a great deal of shock. There is severe pain and limitation of all hip movements. Posterior dislocation of the femoral head produces internal rotation and adduction deformity with shortening of the limb. Anterior dislocations produce external rotation and abduction deformity usually with some lengthening of the limb.

It is sometimes accompanied by sciatic nerve palsy (Chap. XXIX.)

Treatment Manipulative reduction is performed while the patient lies on blankets placed on the floor and the pelvis is steadied by an assistant. The patient is then lifted on to a hip-prop or orthopaedic table and a plaster spica is applied with the hip in neutral rotation and the knee slightly flexed. Foot exercises and quadriceps drill are commenced as soon as the plaster is dry immobilisation is continued for about three months. An abduction frame with skin traction is sometimes ordered.

Complications include myositis ossificans and avascular necrosis of the femoral head.

FRACTURES OF THE FEMUR

Fracture of the neck of the femur This is a common injury in elderly women and is generally due to a trivial accident such as tripping over a doormat The patient complains of pain in the hip and there is a varying degree of external rotation deformity and shortening of the limb In very old and feeble individuals, the shock produced by the fracture may be sufficient to cause death within a few days. In addition, aged patients are very prone to the complications which attend prolonged bed rest, notably hypostatic pneumonia, bed sores, uraemia stiffness of the joints, and mental derangement.

Fracture of the neck of the femur is divided into two main types —

(1) *Intracapsular* when the fracture occurs at the trans-cervical or subcapital level.

(2) *Extracapsular* when the fracture occurs at the inter trochanteric or pertrochanteric level.

The last named readily unite and operative treatment is seldom required. In intracapsular fractures, however slow union and avascular necrosis of the femoral head following depriv ation of blood-supply renders internal fixation necessary This method of treatment is always chosen unless absolutely contra indicated by the state of the general health, and in fact is often a life-saving measure because alternative methods of treatment expose the patient to the complications already mentioned.

Treatment of intracapsular fractures. One of the follow ing methods of treatment may be advised —

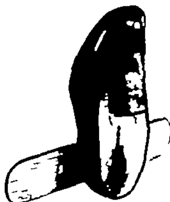


Fig 187

Slipper with wooden cross-bar to prevent external rotation of limb after nailing operation. (*Watson Jones.*)

(1) *Rest in bed* with the limb immobilised between sandbags.

(2) *Simple traction* by means of skin-extensions attached to a weight and running over a pulley fixed to the elevated foot end of the bed.

(3) *Early weight-bearing in a caliper* A bucket top caliper is comfortable for elderly patients. Details regarding measurements and application will be found in Chaps. V and XII.

(4) *Internal fixation by Smith Peterson nail.* The patient is placed on an orthopaedic table and the fracture is reduced by traction and manipulation. The hip is held in the position of abduction and slight internal rotation X rays are taken at each stage of the operation. A guide-wire is introduced into the femoral neck and head, and when it is seen to be in correct position, a three-flanged nail of exactly the right length is hammered along the guide wire until it lies in a central position along the femoral head and neck.

Post-operative treatment As a rule no splintage is ordered, though the patient may wear a slipper nailed to a transverse piece of wood this is to prevent external rotation of the limb. (Fig 187.)

Exercises. Knee exercises are begun the day after operation, performed lying on the sound side After a day or two the patient is encouraged to sit up in bed and gentle hip exercises are commenced. Weight-bearing is allowed when union is firm, which in general is in about three or four months. The nail may or may not be removed at some later date.

Nursing care. These patients often present special problems because of their age and fragility The complications most to be feared are hypostatic pneumonia bed-sores, and stiffness of the joints. A Dunlopillo mattress, water pillow or air ring should be used. The patient must be propped up on pillows in the semi recumbent position at the first possible moment, and should sit up a day or two after operation. She can be turned on to the sound side for treatment of the skin of the back other pressure areas such as the heels and elbows may require treatment. During the first few days, bed bathing and care of the hair and mouth is carried out at the discretion of the ward sister Thereafter the materials for the toilet are placed near at hand, and the patient is encouraged to do things for herself and to move about in bed as much as possible in order to prevent the complications aforementioned. A full nourishing diet and an adequate fluid intake must be ensured.

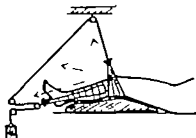


Fig 163.
Hamilton Russell traction.
(*Watson Jones*)

Treatment of extracapsular fractures. One of the following methods of treatment may be ordered —

(1) *Hamilton Russell traction.* This is a means of immobilising the limb by balanced traction. Traction is applied to the limb both longitudinally and in an upwards direction. Horizontal traction is obtained by skin extensions applied in the usual way (Chap XI.) Taylor's perforated zinc oxide strapping is often used. Upward traction is exerted by means of a sling placed under the knee. From the sling a cord is

carried round four pulleys, arranged on a Balkan beam as shown in Fig. 188 The cord runs over a pulley attached to a spreader at the end of the extensions and carries a weight of about 10 lbs. The foot of the bed is then elevated to provide counter traction. A supporting pillow beneath the limb may be ordered.

Nursing care General care is outlined in a previous paragraph It is essential that the patient does not slip down the bed, or the angle of traction is altered. External rotation of the limb must be prevented. The sling under the knee must not become crumpled, or pressure-sores will result. Foot exercises are practised regularly

(2) *Fixation in a plaster spica.* This is an alternative method of treatment though for obvious reasons it is not the ideal method in elderly patients. The reader is referred to Chap IV for details regarding application and nursing care.

(3) *Fixation on an abduction frame with skin extensions.* This method of treatment shares the same hazards as the plaster spica. Application and nursing care is described in Chap. XI.

(4) *Well-leg traction.* A plaster incorporating the well-leg traction apparatus is applied to the sound limb from the toes to the groin there will be strong upward pressure on this limb, so thick pads of felt are placed on the sole of the foot, round the malleoli, and round the knee.

A pin is then driven through the lower end of the tibia *on the affected side and incorporated in a plaster cast extending* from the toes to the upper part of the calf. The traction apparatus is then attached to the pin with the normal limb pushed up and the injured limb pulled down, so that although they lie almost side by side, the normal hip is adducted and the injured hip is abducted. (Fig. 189)

Nursing care The patient is at once made to sit up and is made comfortable on pillows and a bed rest. The sitting posture is maintained continuously and the patient can be lifted on to a bedpan and turned from one side to the other Toe exercises are commenced at once Traction is usually required for about twelve weeks, when non-weight-bearing exercises to regain knee movements are commenced.

Fracture of the shaft of the femur

Fracture of the shaft of the femur may be due to direct or indirect violence. Deformity and shortening of the limb readily occurs because the action of the powerful muscles of the leg produces overriding, angulation and rotation of the fragments.

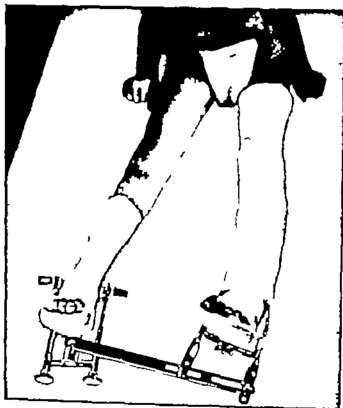


Fig. 189
Well leg traction. (*From Jones*)

Subtrochanteric fracture of the femur. In this injury the proximal fracture is abducted by the gluteal muscles, while the distal fragment is adducted by the adductors. The two fragments are therefore brought into alignment by abducting the limb. Continuous traction may also be necessary to overcome the pull of the adductors. If the fracture is at a lower level the

proximal fragment is not only abducted by the gluteal muscles, but flexed by the ilio-psoas tendon. This type of fracture is treated with the hip-joint in flexion.

Treatment. (1) *Plaster spica.* The limb is immobilised in a plaster spica with the limb abducted. (2) *Jones abduction frame* with skin extensions. (3) *Balanced traction* by means of skin extensions and a Thomas bed-splint tied to the elevated foot-end of the bed, and either flexed at the knee or fitted with a Pearson attachment. (4) *Well-leg traction.* (5) *Open reduction and internal fixation.* Internal fixation may be achieved by means of a Kuntscher nail.

Fracture of mid-shaft of femur. In fracture of the femur at this level, continuous traction is necessary in order to maintain full length and normal alignment of the limb. End-to-end opposition of at least one half of the fractured surfaces is generally considered satisfactory but over-riding, angulation or rotation of the fragments must be corrected. There may be inter-position of muscle-flaps between the bone ends, so that reduction is impossible except by operative means.

Treatment. (1) *Manipulative reduction.* (2) *Immobilisation* by one of two methods:—(a) Fixed skin traction in a Thomas bed-splint. (3) Balanced skin or skeletal traction.

(1) Fixed skin traction in a Thomas' bed splint. *Requirements.*—(a) The mattress is supported by a fracture board, and arrangements are made to elevate the foot end of the bed. (b) A right or left Thomas bed-splint of the correct size: measurements are already described in Chap. V. The ring should fit closely against the ischial tuberosity but it must not fit so tightly as to cause pressure-sores. If the injury is very recent, remember that swelling of the thigh is inevitable. (c) Skin extensions are made of Holland strapping or perforated zinc oxide strapping as described in Chap. XI. Alternatively strips of three inch wide one-way stretch orthopaedic strapping may be used. Elastoplast adheres more quickly and closely to the skin but it is more likely to cause extension sores.

(d) Three metal gutter splints: one must be long enough to support the limb from the upper thigh to the lower calf. Two shorter ones are required to enclose the thigh. Any grooves

in the splints from previous use are ironed out by moulding them over a rounded surface such as a bed rail or hot water pipe. Splints which have become very misshapen are best treated by placing them on the floor and treading out the dents. Alternatively plaster slabs may be used as local splints.

(e) *Other requirements* include three strong calico or leather slings for the splint and paper clips to secure them gauze and calico bandages, splint wool, safety pins, needle and cotton, lampwick extension ties, and tincture of benzoin for painting the skin before Holland strapping is applied.

Reduction of fracture and application of splint. The fracture is reduced by manipulation under general or local anaesthesia. The surgeon supports the limb and maintains traction while the nurse applies extensions in the manner already described. The splint is then gently guided over the limb and pushed firmly against the ischial tuberosity. The slings are placed beneath the limb and the long gutter-splint on top of them. A pad of wool is placed behind the lower end of the femur to help preserve the normal forward curve and to prevent hyper extension of the knee.

The knee joint is held in 5 or 10 flexion at all times. The slings are then adjusted and fastened with the clips. They must be tight enough to allow two-thirds of the thigh to be seen above the lateral bars of the splint and one-third below. One sling supports the femur one the knee and the other the calf. The extension tapes are pulled taut and fastened to the end of the splint. The small gutter-splints are then moulded so that they conform to the shape of the thigh this is done by grasping a splint at each end and twisting it into a spiral shape so that the upper end lies over the trochanter and the lower end in front of the knee. A smaller one is applied to the inner side of the thigh. Alternatively plaster slabs can be used. The whole splint is then covered by a firm encircling bandage. A gallows may be used to support the foot, but it must not interfere with the traction. The position is checked by radiographs and by measurement of the limb.

(2) (a) **Balanced skin traction.** The splint is tied to the raised foot end of the bed. Not only is traction greatly in

creased, but the pressure of the ring in the groin is relieved (Fig 190)

Suspension of the splint may be ordered. The splint is slung on an overhead beam by weights which are so balanced as to allow the patient to move about the bed for nursing purposes.

Nursing care. The bed-splint ring requires the same care as described in Chap. XII. *Pressure-sores must not occur.* The extension tapes are kept taut at all times; forward or backward

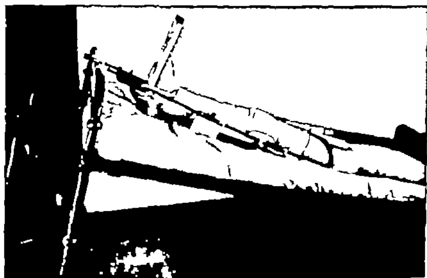


Fig 190.

Thomas bed-splint with skin-extensions applied for fracture of shaft of femur The splint is then tied to the raised foot-end of the bed. The gutter-splints and encircling bandage have been omitted. (*Watson Jones*)

angulation may be corrected by adjustment of the slings; lateral angulation may be corrected by adjustment of the gutter-splints, or by local bandaging over pads of wool. Any such adjustment made by the surgeon must be maintained.

Exercises for the sound limb and for the foot and toes are practised *throughout the period of fixation*, and quadriceps drill is generally introduced in about four weeks. In uncompli-

cated fractures, in which immobilisation has been perfect, union of the fracture is expected in about twelve weeks.

(2) (b) **Skeletal pin and balanced traction.** *Requirements* —(1) A bed elevated at the foot by blocks about 12 ins. high, with either a single or double Balkan beam or a Pearson

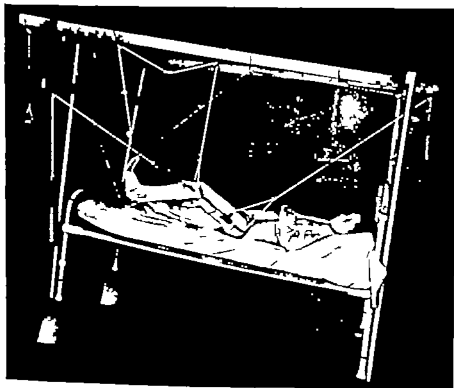


Fig 191

Fracture of shaft of femur treated by balanced weight traction on a Thomas bed splint with Pearson knee-flexion attachment. The gutter splints and encircling bandage have been omitted. (*Watson Jones*)

bed. The mattress is supported by a fracture board. (2) A Thomas splint with Pearson knee-flexion attachment slings, clips, three gutter-splints, splint wool and bandages. (3) A Steinmann pin or Kirschner wire and stirrup (4) Cords, weights and pulleys.

Method of application The skin is prepared as for any other operation. A general or local anaesthetic is given, the pin

is driven through the upper end of the tibia and the stirrup is attached. The splint is then guided over the limb until it is in contact with the ischial tuberosity and the knee flexion attachment is adjusted so that the knee is flexed about 30 The thigh is supported by a gutter-splint, and the slings are adjusted as already described. The splint is then slung from the overhead beam at the level of the knee attachment, and from just below the ring by cords which pass over the head of the bed. A weight of from 10 to 20 lbs. is suspended from the stirrup of the pin over a pulley at the foot of the bed. (Fig. 191) The foot may be supported by a gallows or by a piece of strapping applied to the sole and attached to a cord and small weight at the head of the bed. When over riding of the fracture is corrected, angulation and rotation is also corrected by manipulation, and controlled by gutter-splints, plaster slabs, wool pads, or adjustment of the slings as already described. If the fragments are in satisfactory end to-end opposition, the weight is reduced so that they become impacted. Distraction of the fragments by too heavy weight will cause delayed union or non union of the fracture. *The fracture is reduced by the traction at its initial application not gradually by increasing the weight over a long period* This also causes delayed union or non-union.

Traction is relied upon to maintain end to-end opposition of the fragments and maintain the correct length of the limb, not to control angulation or rotation. This is corrected by deliberate manipulation and controlled by local splintage

When reduction is secure and check X rays show satisfactory position the whole of the splint is covered by a bandage

Nursing care. The weights are so adjusted that while continuous traction is exerted on the fractured limb, the patient and the splinted limb move about the bed as one unit The patient can raise himself for bedpanning and for treatment of the back. If the patient is uncomfortable and slides up or down the bed then the weights are not correctly adjusted. The nurse must not re-arrange the weights herself; she must not allow passers by to bump against them, and there must be no friction between them and the bed or the wall or any other object They must always hang free The bed must not be moved Movement of the pin in its track must be guarded against so as to minimise infection.

Later treatment. A caliper is occasionally ordered. An elastoplast or viscopaste bandage is applied from the toes to the upper calf to prevent oedema, with a crêpe bandage to the knee. The caliper is applied as for tuberculosis of the knee-joint. (Chap XII) *It must be weight relieving* that is, it must be of such a length that the ring is pressed against the tuber ischium and the heel is clear of the boot when the patient

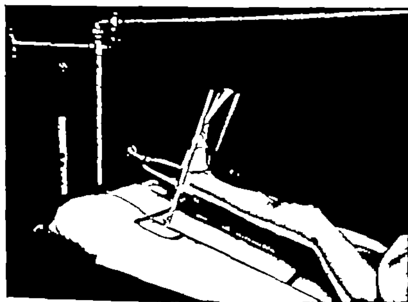


Fig 192.
Supracondylar fracture of femur treated by skeletal traction on a Braun's splint. (*Farquharson*)

stands upright (Fig 35) The caliper is discarded when the fracture is soundly united.

Exercises to recover knee movement are then practised assiduously and re-education in walking completes the treatment.

(3) **Open reduction and internal fixation.** If reduction cannot be obtained by skeletal traction because of interposition of soft parts, internal fixation is supplied either by a tibial graft by a stainless steel plate and screws, or by a Kuntscher nail A plaster spica is applied post-operatively quadriceps drill is begun within a few days, and the plaster is generally removed

in about twelve weeks, when non weight-bearing exercises are commenced.

Supra-condylar fracture of the femur Supra-condylar fracture of the femur is less common than fracture of the mid-shaft. It may be complicated by pressure on the popliteal artery

Treatment consists of manipulation and skeletal traction on a Thomas bed-splint with Pearson flexion piece or on a Braun s splint The knee is held in about 20 of flexion. (Fig. 192.)

INJURIES TO THE KNEE

The knee-joint depends for its stability on its extensor mechanism, the quadriceps muscle. Any injury to the joint produces rapid and severe wasting of this muscle which in itself constitutes a severe disability the knee is deprived of its natural support and is unprotected from the strains of weight bearing It is therefore of vital importance that contraction of the quadriceps is commenced immediately after knee-injuries and continued for five minutes of every waking hour The only exceptions to this rule are cases in which there is an open wound communicating with the joint, or traumatic haemarthrosis even then, quadriceps drill is commenced as soon as possible

Quadriceps drill. This is taught by a physiotherapist but it is such an essential part of the treatment of knee-injuries that the nurse should be prepared to supervise the exercise Vague directions are not enough. The patient should sit or lie in a comfortable position and the exercise is demonstrated on the sound side first; clothing such as tight pyjama trousers must not be allowed to interfere with the exercise Place a hand behind the knee and instruct the patient to press the knee down against it to the command, tighten—and relax. A strong contraction of the quadriceps should then be seen it must be followed by complete relaxation. *Alternate contraction and relaxation of the muscle is performed for five minutes hourly* Some patients cheat by contracting the gluteus maximus instead, the control of the quadriceps being completely inhibited. This must be overcome at all costs. It may be necessary to demonstrate the exercise on oneself or on some other healthy individual. Massage and electrotherapy

is rarely ordered It cannot take the place of the patient's own efforts and only encourages inertia When the patient has mastered the technique of quadriceps contractions, he then progresses to straight leg raising first against gravity only then against the resistance of a weight tied to the foot

Traumatic synovitis. This may follow an injury to the knee producing pain, swelling and effusion.

Treatment (a) A few days rest (b) A pressure bandage (see page 349). (c) Quadriceps drill. (d) A back-splint may be ordered, applied in almost full extension.

Recurrent synovitis may occur if full control of the quadriceps is lost and wasting allowed to occur *Treatment* is as outlined above Weight bearing is restricted until control of the quadriceps is regained.

Traumatic haemarthrosis. This occurs if a severe strain or twist of the knee ruptures the blood-vessels of the synovial membrane The knee swells rapidly with severe pain local heat and rise of temperature.

Treatment (a) Rest (b) Aspiration of the joint (c) A pressure bandage. (d) A back splint may be ordered. (e) Quadriceps drill after ten or fourteen days, or when haemorrhage has ceased.

Injuries of the collateral ligaments. Sprain of the internal lateral ligament is caused by an abduction strain of the extended knee. There is swelling bruising local tenderness, and pain when the knee is manipulated into valgus.

Treatment (a) A pressure bandage. (b) Inside raising to the heel of the shoe (c) Quadriceps drill.

The external lateral ligament is less often injured. Treatment proceeds on the lines already described.

Rupture of the internal lateral ligament. This is evidenced by pain, swelling, bruising local tenderness and lateral instability of the joint

Treatment (a) A plaster cylinder in almost full extension for about two months Any lateral deviation is corrected when the plaster is applied (b) Quadriceps drill.

Operative treatment may consist of a suture or reconstruction of the ligament

Rupture of the external lateral ligament occurs less frequently it is often accompanied by external popliteal nerve palsy Treatment proceeds on the same lines.

Rupture of the cruciate ligaments. The cruciate ligaments may be ruptured by an abduction or hyperextension strain of the knee or by violent blow on the front of the tibia. There is unnatural antero-postero movement of the tibia on the femur

Treatment proceeds on the lines laid down for rupture of the internal lateral ligament.

Operative reconstruction of new ligaments may be undertaken.

Dislocation of the knee. This may be momentary accompanying rupture of the ligaments occasionally it persists.

Treatment (a) Reduction by traction and pressure. (b) Plaster fixation weight bearing is allowed in about six weeks. (c) Quadriceps drill.

Operative treatment consists of open reduction. Dislocation of the knee may be complicated by vascular catastrophe or by nerve involvement such as damage to the external popliteal nerve

Injuries to the semi lunar cartilages. *The internal semilunar cartilage* (medial meniscus) is more often torn than the external, because of its attachment to the internal lateral ligament

The mechanism of injury is a weight bearing rotation strain either when the tibia is forcibly externally rotated on the femur or the femur is internally rotated on the fixed tibia. Tears of the internal semi lunar cartilage occur mainly in miners and footballers, whose occupations subject the knee to the forces described.

Clinical features An accurate and detailed history will reveal the occurrence of a rotation strain. The patient describes a sharp pain on the inner side of the knee accompanied by a tearing sensation He may fall to the ground and be unable to rise The joint may lock in semi flexion. It can be flexed, but not extended extension may be restored spontaneously or by manipulation by the patient or his friends. The

recurrent case learns to unlock the knee for himself but complains that the knee feels unstable and lets him down.

The patient is examined lying on a couch the trousers are removed, and both knees are exposed There may be swelling and effusion, and local tenderness over the affected cartilage. Wasting of the quadriceps may be marked manipulation of the knee by the surgeon may elicit a click or movement of the displaced cartilage may actually be felt

X rays are generally ordered to exclude loose body formation.

Treatment. This consists of an operation to remove the affected cartilage (menisectomy) in order to prevent recurrent trauma to the joint and subsequent osteo-arthritis.

Preparation for operation. Intensive quadriceps drill is introduced at once. In addition to the routine preparation, the skin is prepared from the groin to the toes.

Post-operative treatment A pressure bandage is applied as soon as the operation is completed the surgeon usually prefers to do this himself. The limb is then bandaged to a metal back-splint in full extension. The back-splint should be covered with only a thin layer of wool, because thick padding combined with the bulk of the pressure bandage would not allow full extension of the knee. Alternatively the upper and lower ends of the back-splint may be padded, leaving a gap in the middle in which the pressure bandage will rest The limb is then supported on a pillow

Quadriceps drill is resumed as soon as the patient recovers consciousness, and is continued for five minutes of every hour On the second day the pressure bandage may be cut, especially if there is swelling of the leg and a fresh one applied.

Application of a Jones pressure bandage. Wind a thick layer of splint wool around the knee Start to bandage directly over the joint Take three tight firm turns straight round the knee, add another layer of wool then three more turns of bandage and so on until all the bandage is used up Some surgeons prefer to extend the bandage to the top of the supra patellar pouch, others take it only to the upper border of the patella.

Exercises are continued hourly throughout the day About the eighth or tenth day the sutures are removed and the back splint discarded If the quadriceps are powerful and knee movement perfectly controlled, the patient is allowed up. A longer period of non weight-bearing is advised if there is any effusion in the knee. An inside raising to the heel of the shoe may be ordered.

Re-education in heel-and-toe walking is essential the patient is taught to walk without a limp and the knee must be fully extended at every step.

The external semi-lunar cartilage is less often injured than the internal. Treatment proceeds on the same lines.

Cyst of the external semi-lunar cartilage. A cyst of the external semi-lunar cartilage appears as a localised swelling on the outer side of the knee *Treatment* consists of removal of the cartilage and cyst. After-care proceeds as laid down for removal of a semi-lunar cartilage

Loose bodies in the knee joint. These are due to the following causes —(1) *Osteochondritis dissecans,* a condition in which a small flake of bone becomes detached from the articular surface of the femoral condyle, or more rarely from other parts of the articular surface (2) *Osteoarthritis of the knee* with detachment or fracture of osteophytes. (3) *Chondromata* of the knee-joint

Loose bodies may produce symptoms similar to those of cartilage lesions, such as recurrent pain locking and effusion.

Treatment consists of removal of the loose body Post operative treatment proceeds on the lines already described for menisectomy Synovectomy may be indicated for multiple chondromata.

Rupture of the quadriceps occurs when a violent contraction of the quadriceps is made in attempting to avoid a fall. The patient experiences a painful tearing sensation, the knee-joint fills with blood, and active extension of the knee is lost. A gap can usually be felt between the torn muscle fibres.

Treatment consists of operative repair The limb is im mobilised in full extension on a back-splint or in a plaster cylinder for three weeks. Quadriceps drill and exercises are

commenced in about ten days. Thereafter mobilisation without weight-bearing is commenced and continued until the knee flexes 90.

Fracture of the patella occurs in accidents as described above *Treatment* is by one of the following methods —

(a) Suture of the lateral quadriceps expansion and excision of patella The after-care is as already described for suture of ruptured quadriceps.

(b) Suture of lateral quadriceps expansion and patella, followed by the application of a plaster cast in almost full extension. Quadriceps drill is started at once and weight bearing in plaster in a few days. The plaster is worn for about two months, followed by active exercises and re-education in walking.

Stellate fracture of the patella may occur as a result of direct violence, and is often compound. Those with only minor displacement require a guarding plaster for about three weeks. Quadriceps drill and weight bearing starts immediately Manipulative reduction is sometimes necessary but if the displacement is such as to preclude the restoration of smooth joint surfaces, operative excision of the patella is the usual method of treatment.

Dislocation of the patella. Lateral mobility of the patella varies greatly in different individuals. It may be dislocated by a strain of the knee or by direct violence and is accompanied by a traumatic synovitis of the knee *Treatment* (a) A back splint or guarding plaster for about two months. (b) Quadriceps drill. (c) Active exercises and re-education in walking when the plaster is discarded.

Recurrent dislocation of the patella. This may be due to a congenital abnormality of the knee joint or may follow a previous injury *Treatment* may consist of transplantation of the tibial tubercle to the inner side of the tibia and reconstruction of the capsule, followed by a guarding plaster and quadriceps drill Weight bearing is allowed in about two months.

Fracture of the external condyle of the tibia. This injury is due to an abduction strain of the knee and is usually accompanied by tearing of the medial collateral ligament.

boot worn over the plaster is comfortable and convenient The patient is taught to walk with a normal gait and encouraged to follow his usual pursuits.

Control of oedema When the plaster is finally removed, oedema is controlled by an *elastoplast* or *viscopaste* bandage applied as described in Chap. XXIV

Physiotherapy Exercises for the quadriceps and the toes are practised throughout on removal of plaster mobilising exercises for the knee ankle and foot are introduced, and re-education in *walking completes the treatment.*

Operative reduction and internal fixation This may be advised in those fractures in which it is thought that manipulation is likely to fail, and may consist of a single screw a plate and screws, or a bone graft from the opposite tibia. After *treatment proceeds as already described.*

Fracture of the shaft of the fibula occurring as a result of direct violence is a simple injury which is treated by the application of an elastoplast bandage. It is, however often part and parcel of a Pott s fracture.

INJURIES OF THE ANKLE AND FOOT

Rupture of the tendo-achillis. This injury occurs in the middle-aged and elderly as a result of some unaccustomed strain when the calf-muscles are actively contracting. There is pain, swelling and bruising at the site of rupture and the patient is unable to walk or rise on the toes. A gap in the tendon may be palpable.

Treatment Operative repair is usually required, followed by plaster fixation with the knee flexed and the foot in full equinus. After about a month, a below knee plaster is applied, and the degree of equinus of the foot is gradually reduced in successive plasters. Fixation is usually required for about three months Foot exercises and re-education in walking complete the treatment

Partial rupture of the tendo-achillis is treated by fixation in plaster with the foot in equinus for about two months.

Sprain of the ankle joint is most commonly due to a sudden inversion or plantar flexion strain such as is sustained

in slipping off the pavement There is swelling pain, local tenderness, and bruising just below and in front of the external malleolus. Lateral instability of the joint must be excluded by examination.

Treatment If there is severe swelling the limb i elevated on pillows and firmly bandaged over wool. In the usual case however elastoplast strapping is applied from the toes to the knee using firm even pressure and carrying the strapping from within outwards so that the foot tends to be everted. The foot is held at the right-angle to avoid creases in front of the ankle-joint and no gaps must be left in the strapping. Non weight bearing exercises are commenced at once and walking is allowed in a few days. Full recovery is expected in about three to six months.

Dislocation of the ankle joint. In very severe sprains the external collateral ligament is avulsed from the external malleolus. In addition to the swelling bruising and local tenderness, there is unnatural mobility of the talus when the foot is manipulated into inversion. X ray examination with the foot held in full inversion will reveal the lateral tilt of this bone sometimes a flake of bone is avulsed from the lateral malleolus by the ruptured ligament.

Treatment consists of an unpadded plaster cast with the foot at a right-angle and in neutral rotation Toe exercises are commenced at once and weight bearing is allowed as soon as the plaster is dry The plaster is renewed when the swelling subsides and is worn for about ten weeks thereafter elastoplast strapping is applied from the toes to the knee for a week or two, and foot exercises and re-education in walking are commenced.

Recurrent dislocation of the ankle joint may follow an untreated severe sprain the ankle lets the patient down when walking on uneven ground.

Treatment may consist of an outside raising to the heel of a shoe with a flat wide heel or an inside iron and outside T-strap. Exercises are given to strengthen the peroneal muscles. Operative repair of the external collateral ligament may be advised.

Fracture-dislocation of the ankle joint—(Pott's fracture) Various fracture-dislocations of the ankle joint are referred to as Pott's fracture. The essential feature is a fracture of the lower end of the fibula, with rupture of the internal collateral ligament with or without avulsion of the internal malleolus and lateral or posterior dislocation of the ankle-joint. The fracture may be further complicated by a posterior marginal fracture of the lower end of the tibia. Pott's fracture of the common type is sustained by abduction, adduction or rotation strains of the ankle-joint often as a result of some simple accident such as slipping off the pavement. It is common amongst elderly women.

Treatment. Treatment of Pott's fracture consists of manipulation and plaster fixation with the foot in right-angled dorsiflexion *inversion or eversion of the foot may be required* according to the type of fracture. In cases in which swelling ecchymosis or blistering is severe, the patient may be kept recumbent with the limb elevated on pillows and immobilised in a posterior plaster shell until the swelling subsides. Otherwise reduction is undertaken as soon as possible. In uncomplicated cases, an unpadded plaster cast is applied immediately after reduction, but if gross reactionary swelling is expected, a padded cast is applied and the patient is confined to bed. The plaster is changed to an unpaddded one as soon as the swelling subsides. In cases without gross bone damage and in which reduction is secure weight-bearing in plaster is allowed in a few days; in more severe cases it is allowed as soon as an unpadded plaster can be applied. The patient either wears a plaster boot or a walking iron is incorporated in the plaster. Toe exercises are practised throughout the period of immobilisation, which in general is not less than eight to ten weeks. Walking in plaster is encouraged as circulation and muscle tone is thereby maintained.

Later treatment. As in all lower leg fractures, elastoplast strapping or viscopaste bandage is applied from the toe to the knee on removal of plaster to prevent swelling. Movement of the joint is recovered by active exercises. Re-education in walking is essential an inside raising to the heel of the shoe may be ordered. In very heavy patients further protection of the

ankle joint by an outside iron and inside T-strap is occasionally advised.

Open reduction and internal fixation by one or more screws may be undertaken in very unstable fractures.

Displacement of the lower tibial epiphysis. Treatment of this injury proceeds on the same lines as for a Pott's fracture. Compression of the epiphysis may very occasionally lead to premature fusion and arrest of growth of the tibia with late deformity.

Fractures of the bones of the foot

Fracture of the calcaneum (os calcis) is usually the result of a fall from a height when the patient lands heavily on his heels. It is not uncommonly accompanied by a fracture of the spine. The diagnosis is made from the typical history of a fall on the feet, the painful and tender heel, the broadening of the os calcis and the limitation of inversion-eversion movement when movement of the ankle is *relatively free*. Radiographs in special positions may be ordered.

Treatment. There are various schools of thought in the treatment of this injury but the most widely held view at the present moment is that no fixation should be applied. Older methods utilised *plaster fixation and mechanical devices* to attain and maintain reduction. These methods are credited with causing permanent stiffness and pain in the foot.

The patient is prevented *from weight bearing on the injured limb for* twelve weeks, and is taught exercises to develop all muscle groups controlling the foot and ankle. Weight-bearing on crutches is permitted provided the injured foot is not put to the ground, but if both os calces are fractured, as is often the case, the patient is confined to bed for the full period of twelve weeks.

Fracture of the os calcis with gross displacement and subsequent avascular necrosis may necessitate arthrodesis of the sub astragaloid or even the mid tarsal joints.

Fractures and dislocations of the talus (astragalus)
Fracture of the talus is sustained in dorsiflexion injuries of the foot and may be accompanied by partial or complete dislocation

three weeks. Operative reduction is sometimes necessary. Mal-united fracture of the metatarsal neck is treated by excision of the metatarsal head.

Fractures of the toes. Fracture of the proximal phalanx of the toe is usually due to direct violence; the displacement corresponds to similar fractures of the proximal phalanges of the fingers—flexion of the distal interphalangeal joint and hyperextension of the proximal interphalangeal joint.

Treatment proceeds on the same lines, i.e. the toe is immobilised in flexion until union is sound.

Comminuted fracture of the phalanges of the great toe is due to a direct crushing injury such as a weight dropped on the toe, and may be compound.

Treatment consists of a collodion and ribbon-gauze splint. Weight-bearing is allowed in a boot with the toe-cap cut out and fitted with a metatarsal bar to the sole. Drilling of the toenail may be required to relieve the pain of a sub-ungual haematoma.

CHAPTER XXVII

INJURIES OF THE SPINE, RIBS AND PELVIS

Fracture of the spine. Fracture of a vertebral body Treatment. Postural reduction and application f plaster by the Watson-Jones method. Later treatment. Treatment by recumbency and exercises. Fracture dislocation of the spine. Fracture or dislocation of the cervical spine. Crush fracture of cervical vertebral body Application of plaster jacket. Dislocation or fracture-dislocation of cervical spine Treatment Skull traction Fracture or dislocation of the spine with paraplegia. Treatment. Immobilisation in a plaster bed. Nursing care. Prevention of pressure sores. Management of bowel and bladder Supra pubic cystostomy Later treatment. Fracture of a transverse process. Treatment. Fracture of the ribs. Treatment by strapping Fracture of the pelvis. Treatment. Watson-Jones postural reduction and double plaster spica. Suspensory sling Continuous traction.

FRACTURE OF THE SPINE

FRACTURE of the spine may involve the vertebral body or one of the processes such as the transverse or spinous process. The close proximity of the spinal cord should be remembered; damage to this structure may result in paraplegia.

Fracture of a vertebral body occurs most commonly in the dorso-lumbar region, and is due to a flexion injury such as is sustained in falling from a height and landing on the heels, buttocks, head or shoulders. There is generally a small localised kyphos due to prominence of one spinous process. The patient may or may not complain of pain and there may be evidence of damage to the spinal cord.

Treatment. In transporting a patient suspected of having sustained a fracture of the spine, it is important to avoid forward flexion of the spine. The patient should therefore be kept in the prone position with pillows under the head and chest In simple fracture, treatment consists of postural reduction and the application of a plaster jacket.

Postural reduction and application of plaster jacket by the Watson Jones method As a rule anaesthesia is unneces-

sary though spinal anaesthesia is sometimes employed. Two tables, one about a foot higher than the other are arranged end to end so that the space between them is a little more than the length of the patient s trunk All materials for applying the plaster jacket are placed at hand. (See Chap IV) A double layer of vesting is applied and stitched between the legs. The patient is then lifted into position the arms are supported on the higher table which is clear of the chest the lower table supports the legs only so far as the upper thighs, so that the trunk sags down between them until the limit of hyperextension

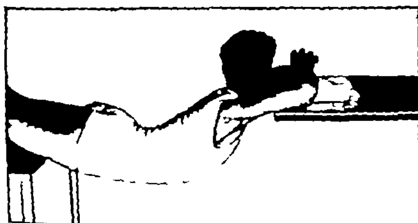


Fig 195

Postural reduction of fracture of spine Note that the higher table is clear of the chest, and the legs are supported only to the upper thighs. A plaster jacket is applied in this position. (Watson Jones)

of the spine is reached. (Fig 195) A loop of bandage tied to the upper table and grasped by the patient sometimes gives a sense of security and aids relaxation. Strips of adhesive felt may be placed around the kyphos, so as to avoid pressure-sores. The plaster jacket is then quickly and smoothly applied. It must extend from the symphysis pubis to the supra sternal notch in front and from the tip of the coccyx to the scapulae behind, so as to prevent the smallest degree of forward flexion of the spine (Fig 196)

When the plaster is hard, the patient is lifted on to pillows, preferably in the prone position, otherwise with several pillows

arranged so as to fill in the hollow of the back. The plaster is trimmed at the axillae to allow movement of the arms. Similarly it can be trimmed over the thighs to allow the patient to sit in a semi recumbent position, but not sufficient to allow him to sit bolt upright *In no circumstances must it be cut away over the sternum and clavicles or over the symphysis pubis* The patient can be made comfortable by arranging numerous pillows so that the spine is supported in its arched position and the shoulders and thighs fall away from the jacket in front. Other nursing details are described in Chap IV



Fig 196.
Hyperextension jacket for fracture of spine Note that it extends from the symphysis pubis to above the clavicles.
(*Watson Jones*)

Later treatment. *Exercises* for the spinal muscles are commenced as soon as the plaster is dry and are practised regularly throughout the period of immobilisation The patient lies prone and whilst an assistant steadies the legs, the head and shoulders are raised from the bed. The patient then raises first one leg and then the other in the air with the knees extended as his strength increases he raises both legs simultaneously and finally the head and shoulders and both legs are hyperextended at the same time. After about four weeks, the position of the fracture may be checked by radiographs and a new plaster applied by the same method. The jacket is worn for about four to six months, depending on the rate of union When this is assured, mobilising and strengthening exercises are practised until recovery is complete.

Treatment by simple recumbency and active exercises. The most modern method of treatment of fracture of a vertebral body consists of simple rest in bed, combined with back raising exercises which are commenced at once Plaster fixation is not employed.

Fracture-dislocation of the spine is a dangerous injury because there is a likelihood of damage to the spinal cord with resulting paraplegia.

Treatment consists of open operation, which is followed by the application of a plaster jacket or more frequently by recumbency on a plaster bed.



Fig 197

Reduction of fracture of cervical spine. The cervical spine is fully extended while the shoulders are supported on a thin strip of wood. A plaster jacket is applied in this position. *(By courtesy of Journal of Bone and Joint Surgery and Sir Reginald Watson Jones.)*

Fracture or dislocation of the cervical spine. Crush fractures of the cervical vertebral bodies are less common than in other regions of the spine. Injuries to this region are commonly dislocations or fracture-dislocations. X rays of the spine in the position of flexion may be ordered in doubtful cases.

Simple crush fracture of a cervical vertebral body *Treatment* consists of reduction by hyperextension and immobilisation in a plaster jacket.

Method of application. A long piece of smooth polished wood 3 ins. wide is placed on a table so that it projects about a foot from the end (Fig 197). Alternatively the posterior bar of a shoulder prop may be utilised. The patient is placed on his

back on the table, supported on the strip of wood as far as the shoulders. The surgeon grasps the head and slowly extends the cervical spine. The neck is hyper-extended to its limit, but the head is not tilted back on the atlas so far as to prevent the patient seeing the ground in front of him when weight-bearing in plaster is commenced. The arms are abducted out of the way wool roll padding is applied in figures-of-eight over the neck, chin, occiput and trunk. The plaster jacket is then quickly and smoothly applied. It must be closely moulded under the occiput and the mandible and extend over the shoulders and down to the iliac crests. The Minerva jacket (Fig. 115) encloses the forehead to the eyebrows In this type of jacket the plaster can be cut away beneath the chin so that the movement of the jaw is permitted. If the forehead is not encircled, the angles of the jaws must be included in the plaster A window is cut over each ear and sufficient plaster is cut away at the axillae to allow movement of the arms. The patient is returned to bed and the plaster is supported on pillows as already described. In spite of its formidable appearance, this type of jacket is surprisingly well tolerated and uncomplicated cases are usually allowed up in a few days.

Dislocation or fracture-dislocation of the cervical spine. This is a more serious injury in which the interarticular facets may be locked together Paraplegia from contusion or compression of the spinal cord is frequently present and a number of these cases are rapidly fatal.

Treatment Manipulative reduction as already described may be successful but if there is interlocking of the inter articular facets strong traction is necessary

Skull traction. (Fig. 198.) Calipers are inserted into the temporal bones under local anaesthesia the head of the bed is then elevated, and a 15 lb or 20 lb weight is suspended over a pulley arranged so that traction is exerted in flexion. X rays are taken at intervals until reduction is secured The weight is then reduced to about 10 lbs. and the pulley is lowered so that the neck is extended. Traction is continued for from four to eight weeks, depending on the st ility of the reduc and the general condition of t [illegible] A plaster [illegible] then be

applied and retained until union is sound. Operative excision of interlocked facets is sometimes indicated.

Fracture or dislocation of the spine with paraplegia

Paraplegia in fracture or dislocation of the spine may be due to contusion, compression, or traction injury If the cord itself is not seriously damaged complete recovery is possible once the fracture or dislocation is reduced. Paraplegia may be



Fig 198.
Skull traction for fracture of cervical spine (*Farquharson*)

partial or complete In complete lesions, there is flaccid motor paralysis, loss of sensation, trophic changes in the skin, incontinence of faeces and retention of urine. If the paralysis is incomplete then it is probably due to bruising of the cord, and at least some degree of recovery may be expected. But if total paralysis shows no sign of recovery in a few weeks, complete transection of the cord is almost certainly present The surgeon will often seek the advice of a neurologist

Treatment consists of reduction of the fracture or dislocation and immobilisation in a hyperextension plaster bed.

Method of immobilisation The patient lies prone with the spine extended by sandbags and pillows placed under the shoulder The arms are placed by the sides and the feet hang

over the end of the table The plaster bed is then quickly and carefully made by one of the two methods described in Chap. IV It is essential that it is absolutely smooth When the bed has set, it is removed from the patient's body trimmed and lined with three layers of splint wool covered by stockinette Meanwhile the patient's back is thoroughly cleaned and rubbed with soap and water As this is an emergency the bed cannot be dried in the ordinary way it is replaced on the patient's body and he is turned into it immediately It is then supported either on firm pillows covered with mackintosh and arranged so as to fit the curves of the bed, or on a Thomas straight frame from which the saddle has been removed. If the general condition permits, an anterior shell is made forthwith, which can be used as a turning case so that a new bed can be made in the course of a few days. This is dried, lined and mounted on blocks in the usual manner (Fig 89)

Nursing care. These patients require unremitting care from the first moment

Prevention of pressure sores. This is especially important during the first few days, when the trophic changes in the skin are rapidly taking place Pressure-sores are also due to the inability of the patient to move to the loss of skin sensation so that the patient is unconscious of pressure and to dampness of the skin from incontinence of urine and faeces. It is essential that these patients are kept dry by careful arrangement of urinals and by correct management of the bladder and bowel. The patient is turned frequently for treatment of the skin of the back A smoothly made and perfectly fitted plaster bed should not cause pressure-sores The patient is always turned after an enema has been given and the skin of the buttocks may be contaminated The heels and malleoli can be completely relieved from pressure by the application of club-foot shoes as described for Pott paraplegia in Chap X. These also prevent foot-drop It is advisable to lip the calf piece of the club-foot shoe underneath the plaster bed so that pressure on the calf is avoided. Alternatively smoothly moulded plaster shells may be used, provided they re [illegible]

Management of the bowel and bladder A simple enema given every second or third day is usually sufficient to control

the incontinence of faeces and prevent constant soiling. The advice of a urologist is frequently sought in connection with the management of the bladder. Retention of urine must be relieved at once or distention of the bladder will cause ulceration of the mucosa. The bladder is not allowed to distend and overflow. Instrumentation, such as an indwelling catheter or repeated catheterisation is to be avoided. Manual expression of the bladder may be employed, by gently pressing the clenched fist against the lower abdomen. This method of emptying the bladder is particularly successful in women.

Supra-pubic cystostomy is generally performed as soon as possible: a de Pezzer or Malecot catheter is introduced into the bladder and attached by rubber tubing to a bottle placed on the floor at the side of the bed. Bladder washes may be ordered, and the catheter is changed as often as is ordered. Scrupulous aseptic technique and the utmost gentleness must be employed: infection of the urinary tract is often the cause of death in these cases. *Tidal drainage* is often advised as it provides regular lavage and preserves the tone of the bladder. The fluid intake and output is charted and the patient is encouraged to drink large quantities of fluid. Sulphonamides or streptomycin may be ordered.

Later treatment. As time goes on flaccid paralysis may be replaced by spastic paralysis. If the paralysis is permanent, the patient may be fitted with a spinal support strapped to two calipers, and is taught to walk on crutches with a tripod gait. (Fig. 169.) Otherwise he may get about in a wheel-chair or special invalid chair. A rubber urinal is worn and efforts to prevent urinary sepsis must not be relaxed. Incontinence of faeces is controlled by enemata. The patient can be lifted in and out of a bath. He should sleep on a sorbo rubber mattress and unremitting care of the skin is necessary to prevent trophic sores.

Cases of irrecoverable paraplegia may be transferred to a paraplegia unit where special arrangements are made for their rehabilitation and care.

Fracture of a transverse process

Fracture of a transverse process nearly always occurs in the lumbar region, and is usually due to a sudden and powerful

contraction of the quadratus lumborum. Tearing of this muscle results in avulsion of the transverse process the accompanying soft tissue damage may be extensive, and is characterised by *pain in the flank, which is aggravated by movement of the trunk.*

Treatment A mild degree of injury without separation of the fragments is treated by firm strapping to the lumbar region. Weight bearing is generally allowed in a few days, and exercises are commenced in three or four weeks.

Severe cases with fracture of several transverse processes and tearing of the lumbar muscles, require fixation in a plaster jacket extending from the nipple line to the lower pelvis. It is generally applied in the standing position, and is retained for about two months. Weight bearing is allowed in a few days and exercises for the spinal muscles are commenced in about one month full spinal exercises are gradually introduced when the plaster is removed



Fig 199
Fracture of the ribs treated by application f strapping (*Aayler*)

FRACTURE OF THE RIBS

Fracture of the ribs is rarely sustained by children because of the elasticity of the chest wall. In adults, it is usually due to a crushing injury when the rib gives way at the site of greatest curvature, i.e. the angle. There is pain at the site of injury and respirations are painful and shallow

Treatment. Long strips of adhesive strapping are applied to the chest wall extending either three-quarters of the way round or in more severe cases, encircling the chest completely (Fig 199) The strapping is applied from below upwards, and as each strip is applied, the patient is instructed breathe in—breath out" the strapping is pulled tightly on the second

command, so that it is applied whilst the chest is in the position of expiration. Strapping is generally retained for about three weeks. Fracture of the ribs may be accompanied by damage to the lung and haemothorax or pneumothorax may result

FRACTURE OF THE PELVIS

Fracture of the pelvis is produced by crushing injuries, and may be accompanied by rupture of the bladder or urethra. This complication receives primary consideration and is treated by operative repair. Fracture of the pelvis without displacement is treated by recumbency for a few weeks. The patient is

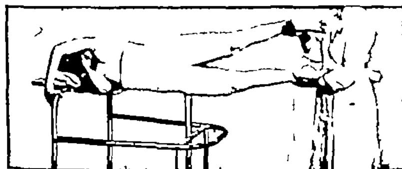


Fig. 200
Application of double hip spica in lateral recumbency for fracture of the pelvis. (*Watson Jones*)

nursed on his back. Fracture of the pelvis with displacement of fragments or dislocation of the symphysis pubis or sacro-iliac joints may be treated by the following methods —

(1) *Watson-Jones postural reduction and double plaster spica fixation* An anaesthetic may or may not be given. The upright perineal post is removed from a hip-prop and the patient is laid on it on the sound side. If greater lateral pressure is required he is laid on the injured side. The body is then covered with a thin layer of wool roll, the iliac crests and sacrum are protected with felt, and a double spica is applied. (Fig. 200) It must be closely moulded round the pelvis and lumbar spine. When it has set the hip-prop is cut out and the hole in the plaster is filled in with padding and covered with a plaster bandage.

When the plaster is dry the patient is encouraged to lie on his side. Leg exercises are commenced at once. The plaster is usually changed after about six weeks and is retained for about three months.



Fig. 201
Fracture of the pelvis treated by suspensory sling. (Fe gube sen)

(2) *Suspensory sling.* A canvas sling is passed beneath the pelvis and attached to cords and weights, in the manner shown in Fig. 201. Side-to-side compression of the pelvic girdle is provided, and the patient is able to lift himself for nursing purposes.

(3) *Continuous traction* is sometimes used in combination with one or other of the aforementioned methods.

CHAPTER XXVIII

BIRTH FRACTURES AND COMPOUND FRACTURES

Birth fractures. Fracture of the humerus. Fracture of the fem Fracture of tibia, congenital pseudoarthrosis f tibia. Compound fractures. Immediate nursing care. Operative treatment Afte treatment. Treatment of infected compound fractures Secondary haemorrhage. Later treatment.

Birth fractures

THE shafts of the humerus, the femur and the tibia are the commonest sites of fracture in the newly-born baby They are usually sustained during delivery of the infant Multiple fractures may be present if there is congenital fragility of bone

Fracture of the humerus. A pad of wool of sufficient size to maintain a moderate degree of abduction is placed in the axilla, and the arm is bandaged to the side.

Fracture of the femur is treated by the application of skin extensions to both legs, which are then flexed to the right angle and tied to a bar fixed over the cot. The extension ties must be fastened at sufficient tension to lift the buttocks just clear of the bed. (Fig. 202.)



Fig 202.
Birth fracture of femur treated by skin extensions fastened to an overhead beam. (Naylor)

Fracture of the tibia—congenital pseudoarthrosis of tibia A fracture of the shaft of the tibia in a newly-born baby frequently fails to unite. This condition is known as congenital pseudoarthrosis of tibia. Prolonged immobilisation in plaster

may be advised, but internal fixation is frequently necessary *This may consist of a graft taken from the fibula, or from the tibia of the other side, or from the tibia of the child's parent.*

Compound fractures

The shock which follows any severe injury may in the case of a compound fracture be accompanied by haemorrhage. These factors must receive primary consideration, but excision of the wound and reduction of the fracture is undertaken at the earliest possible moment.

Immediate nursing care. The patient is received into a warm bed in a quiet corner of the ward, and the foot of the bed is elevated. Clothing is cut away around the wound, and a simple dressing is applied Emergency splintage such as a gutter splint or plaster shell may be ordered. Haemorrhage is controlled by a firm pad and bandage; a tourniquet is not used unless absolutely necessary Anti-tetanic or anti-gas-gangrene serum is usually given. Warmth is essential, and unless the patient is unconscious or has internal injuries, warm sweetened drinks may be given freely Rectal salines may be ordered. The pulse rate is recorded every fifteen minutes. A rising pulse-rate and increasing pallor combined with cold sweating is reported to the surgeon at once. The administration of oxygen and stimulants may be ordered morphia or omnopon may be ordered for the relief of pain. Transfusion of whole blood or of plasma may be commenced at once and continued throughout the operation.

Operative treatment consists of excision of the wound and reduction of the fracture.

After treatment A closed padded plaster is applied in the theatre, after application of a dressing The limb is elevated on return to the ward. Chemotherapy may be ordered and the temperature chart is closely watched.

Treatment of infected compound fractures. If infection is already present, or develops after excision of the wound, further excision of tissues to establish free drainage may be necessary The nursing care is similar to that described for acute osteomyelitis (Chap. XIV) and the same principles with regard to changes of plaster apply i.e. so long as the patient is apyrexial

and well, staining of the plaster is not regarded as an indication for changing it. The wound will heal more quickly undisturbed under a closed plaster than if it were constantly being traumatised by meddlesome dressing. Sometimes the pus tracks along the limb under the plaster and causes excoriation of the skin. The plaster should then be changed and the skin is protected by vaseline gauze.

Secondary haemorrhage may be due to erosion of the walls of blood vessels, and is indicated by a sudden onset of pain, rise of pulse-rate, pallor and faintness. Such signs must be reported to the surgeon at once. Morphia is generally ordered, and blood transfusion is commenced. Exploration of the wound and ligation of the bleeding vessel may be performed.

Later treatment. If infection has not occurred after excision of the wound, an unpadded plaster is applied in a few weeks and treatment proceeds as already described for similar simple fractures. If infection has occurred, union of the fracture will be delayed, and *prolonged* immobilisation is often necessary. Sequestrectomy may be required.

Chapter XXIX

PERIPHERAL NERVE LESIONS

Causes. Classification. Clinical features. Treatment. Conservative treatment. Splintage. Physiotherapy. Operative treatment. Nursing care in peripheral nerve lesions. Lesions of peripheral nerves in the upper limb. The circumflex nerve. Treatment. The musculo-spiral nerve. Treatment. Operative treatment. The median nerve. Treatment. The ulnar nerve. Treatment. Delayed ulnar paralysis. Treatment. Lesions of the brachial plexus. Treatment. Birth palsies. Erb's palsy. Treatment. Klumpke's palsy. Treatment. Lesion of peripheral nerves in the lower limb. The great sciatic nerve. Treatment. The external popliteal nerve. Treatment.

PERIPHERAL nerve lesions arise in many ways. A nerve may be severed by direct violence such as a laceration; it may be compressed by pressure within the body, as in a haemorrhage, or by some outside agency such as a splint or plaster. It may be injured by traction, as when the circumflex nerve is stretched in dislocation of the shoulder joint, or loss of blood-supply may cause death of the axon cylinder, as in Volkmann's ischaemia. (Chap. XXIV.) A peripheral nerve is sometimes affected by poisons such as arsenic or lead.

Peripheral nerve lesions are classified as follows:—

(1) Complete division of a nerve and its supporting sheath—neurotmesis.

(2) A lesion in continuity with crushing or compression of axons without rupture of supporting sheath—axonotmesis.

(3) Transient nerve block—neuropraxia.

Clinical features. The lesion may be partial or complete depending on the degree of injury to the nerve. Peripheral nerves contain both motor, sensory and sympathetic nerve fibres. A lesion of such a nerve will therefore present the following features:—

(1) *Paralysis* of all muscles supplied by the nerve below the level of injury.

(2) *Anaesthesia* of the area of skin supplied by the nerve.

(3) *Trophic changes in the skin.*

(4) *Loss of certain tendon reflexes.*

Treatment. Treatment is largely determined by the degree of certainty as to whether the lesion is a complete division of the nerve, a lesion in continuity or a transient nerve block. In the early days this may be difficult to decide, but in cases in which there is an obvious cause of complete severance of a nerve, such as a deep wound, early operative suture is undertaken. This is done when there is no risk of infection, usually when healing of the wound has taken place. Paralysis due to a lesion in continuity often recovers spontaneously with conservative treatment; if not, exploration is undertaken at a later date. Paralysis due to transient nerve block always recovers with conservative treatment.

Conservative treatment. (1) *Splintage* is applied to prevent overstretching of paralysed muscles and deformity from contracture of healthy ones or from the action of gravity. In the case of the hand, in which mobility of joints is of paramount importance, splints which allow controlled movement are usually ordered.

(2) *Physiotherapy.* This is aimed at the re-education of paralysed muscles and the prevention of contractures and joint stiffness. The last named is of vital importance, because even if treatment is successful and the paralysed muscles recover, the function of the limb will be greatly impaired if the joints have been allowed to become permanently stiff. Joint stiffness and contractures must therefore be prevented by giving passive movements at least once each day. Active exercises are given to re-educate paralysed muscles, and electrical stimulation is frequently ordered because it retains muscle bulk and minimises wasting.

Operative treatment. (1) *Nerve suture.* This is followed by immobilisation in a plaster cast in a position which relieves tension on the nerve. For example, suture of the median nerve would require fixation with the elbow and wrist flexed. The joints are gradually straightened as the nerve unites. The rate of regeneration of a nerve is estimated at about one inch a month. Physiotherapy is commenced as soon as plaster fixation is abandoned.

(2) *Tendon transplants* are performed in cases of irrecoverable paralysis; for example, some of the flexor tendons of the

wrist are transplanted to the extensors in cases of irrecoverable musculo-spiral palsy

(3) *Operations on bone* include bone-block operations and stabilisation of joints. These operations are performed to correct deformity to provide stable joints, and to improve the function of the limb as a whole.

Nursing care in peripheral nerve lesions

(1) The limb must be kept at an even temperature. Do not apply direct heat, for fear of burning the insensitive skin; the patient should be warned against touching hot plates, radiators, etc. on the other hand, a paralysed limb should never be allowed to become cold and stiff.

(2) Splintage must fit comfortably and perform the function for which it is designed, i.e. the prevention of overstretching of paralysed muscles and deformity due to contracture of healthy muscles or the action of gravity

(3) The skin must be kept clean and dry *Pressure sores from splints or plasters must not occur* If there are trophic changes in the skin they will heal only very slowly

(4) Avoid swelling by support and by preserving full movement of the joints chronic oedema will result in fibrosis.

(5) Never allow a paralysed limb to dangle helplessly Joints which are deprived of their muscular supports are easily dislocated.

(6) Remember the importance of physiotherapy in preventing joint stiffness and in the re-education of paralysed muscles.

LESIONS OF PERIPHERAL NERVES IN THE UPPER LIMB

The circumflex nerve. The circumflex nerve lies just below the shoulder joint, and for that reason is liable to be stretched in a fracture of the humerus or dislocation of the shoulder There is partial or complete paralysis of the deltoid so that the arm cannot be abducted, and there is anaesthesia of the skin over the lower part of the deltoid.

Treatment. *Splintage* consists of an abduction splint. This may be a Littler-Jones splint as shown in Fig. 47 or one of the platform type (Fig 48) A plaster spica with removable lid

may be ordered if neither of these splints is available Unless otherwise ordered, the splint is worn continuously except when exercises are being given, and the arm is not allowed to drop helplessly by the side

An abduction splint is very uncomfortable to wear in bed, and the surgeon may allow the patient to sleep with numerous pillows banked up so as to support the limb in right-angled abduction. The arm can be firmly bandaged to the uppermost pillow

Physiotherapy The shoulder joint is carried passively through its full range of movement at least once each day this is particularly important in elderly patients, and it is essential that full external rotation of the shoulder is preserved. Active exercises and electrotherapy are also given.

The musculo-spiral nerve may be severed in lacerations of the arm, or compressed in fracture of the humerus. It is also liable to compression from splints and plasters, from crutches in the axilla, or from a chair-back in Saturday night paralysis. It is sometimes compressed by a *tourniquet*, or by the edge of an operating table if the arm is allowed to hang over the side.

There is complete wrist-drop due to paralysis of all the extensors of the wrist. There is also loss of extension of the thumb and of the metacarpo-phalangeal joints of the fingers, though the interphalangeal joints can still be extended by the lumbricals and interossei. The grasp is weakened, because the extensors cannot carry out their normal function as fixation agents of the wrist. In the normal hand, the wrist is stabilised by its extensors to allow the flexors to function in grasping an object. The nerve to the triceps usually escapes, as it is given off in the axilla. Anaesthesia is usually confined to a small area over the dorsum of the web of the thumb The prognosis is good.

Treatment. *Splintage* consists of a cock up splint which must not extend beyond the proximal interphalangeal joints of the fingers. A short metal cock up splint as shown in Fig 51 may be used as a temporary measure, but a long cock up is never used, as stiffness of the fingers is more disabling than the paralysis. Other splints include those depicted in Figs.

203 and 204. They allow flexion and extension of the fingers without stretching the wrist extensors. If those splints are not available, an anterior plaster shell may be used to support the limb. A posterior plaster shell may be fitted with traction loops attached to finger-stalls. Active flexion of the fingers and thumb is then possible against the resistance of the traction loops, which take the place of the paralysed extensors.

Physiotherapy is instituted at once, and proceeds on the lines already described.



Fig. 203.
Leather cock-up splint for musculo-spiral paralysis. Note elastic extension straps for the fingers. (A. glor)



Operative treatment. Nerve suture may be performed followed by fixation in plaster with the wrist dorsiflexed and the elbow in a moderate degree of flexion, depending upon the site of suture. In irrecoverable cases, tendon transplantation is often employed. The pronator radii teres is stitched to the extensor tendons of the wrist, the flexor carpi ulnaris to the extensor tendon of the fingers, and the flexor carpi radialis to that of the thumb.

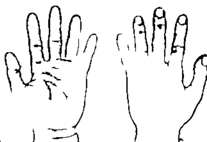
The median nerve may be injured in fractures around the elbow, or by lacerations of the forearm, wrist or hand. It may be involved in Volkmann's ischaemic contracture. There is paralysis of the flexors of the wrist and fingers, except for the terminal phalanges of the ring and little finger. The muscles

of the thenar eminence are paralysed, so that the thumb is powerless and cannot be abducted or opposed to the little finger The thenar eminence becomes flattened and the thumb assumes a characteristic position as it falls back into the same plane as the fingers. The hand is powerless to grasp an object or even to fasten buttons, and the disability is severe An im-



Fig 204.
Heavy working pl t for musculo spiral paral (Naylor)

portant feature i the anaesthesia over the palm of the hand and over the tips of the fingers and thumb, except for the tip of th little finger and the ulnar half of the ring finger (Fig 20.) This is a serious matter because the patient is unable to feel objects (for example in his pockets) and also because it renders him liable to burns from cigarettes, hot plates, et Trophic changes in the skin and nails are marked median palsy is commonly associated with pain, sweating and col lness of the skin of the hand. This is known as causalgia."



F g
Area f anaesthesia l complete edia paral (H from J se

Treatment. *Splintage* i applied to hold the thumb in opposition to the fingers. Thi may take the form of a leather

splint such as is shown in Fig. 206 or an anterior plaster shell holding the fingers and thumb in the optimum position i.e. as in holding a glass.

Physiotherapy is always ordered.

Operative treatment Nerve suture is followed by fixation in a plaster cast holding the wrist and elbow in flexion.

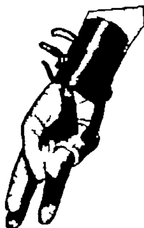


Fig. 206.
Splint for median nerve paralysis. Note that the thumb is held in opposition to the little finger (*Naylor*)

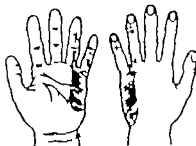


Fig 207
Area of anaesthesia in complete ulnar paralysis. (*Watson Jones*)

The ulnar nerve may be injured in fractures around the elbow joint or in lacerations of the arm. In common with the median nerve, it may be involved in Volkmann s ischaemic con tracture. There is paralysis of the interossei, the inner two lumbricals, the muscles of the hypothenar eminence, part of the flexor brevis pollicis, and the adductor of the thumb. Wasting of the interossei is shown by the characteristic hollows between the metacarpal bones. Paralysis of these muscles, which nor mally flex the metacarpo-phalangeal joints and extend the inter phalangeal joints, causes a claw hand due to the action of the opposing muscles. The little finger is immobilised and cannot be opposed to the thumb so that fine movements of the hand are lost Anaesthesia of the skin is confined to the ulnar side of the hand, the tip of the little finger and the ulnar half of the ring finger (Fig 207) When the patient grasps a piece of cardboard with the two thumbs laid flat the terminal inter phalangeal joint on the affected side cannot be extended be-

cause of the paralysis of the thumb adductor and the unopposed action of the flexo longus pollicis.

In comparing lesions of the median and ulnar nerves, it is interesting to note that in the former there is loss of gross movements of the hand such as are required to grasp a tumbler but in ulnar palsy the disability is due to loss of fine movements, such as are required to play a piano.

Treatment. *Splintage* may consist of a dorsal plaster shell holding the fingers in flexion at the metacarpo-phalangeal joints and extension at the interphalangeal joints. Splints of the





Fig 208.
Knuckle duster splint fo ulnar paralysis. (*Naylor*)

knuckle-duster or mouse trap type such as are shown in Figs. 208 and 209 are frequently ordered, to prevent con tractures and clawing of the hand.

Physiotherapy is always ordered.

Operative treatment Nerve suture is followed by fixation in plaster with the wrist and elbow in the flexed position.

Delayed ulnar paralysis may follow a fracture of the external condyle of the humerus with subsequent cubitus valgus deformity (Fig. 178) The nerve becomes stretched in its lengthened course and ulnar palsy develops many years after the original injury

Treatment is by transposition of the ulnar nerve from its normal bed behind the internal condyle of the humerus to a new position in the muscles in front of the elbow joint This relieves tension and friction on the nerve by shortening its path.

Lesions of the brachial plexus are commonly caused by traction on the arm, or by injuries which force the arm or shoulder into abnormal positions. In lesions of the whole plexus, the arm is completely paralysed and anaesthetic and hangs uselessly by the side

Treatment Splintage may be ordered holding all joints in the optimum position. *Physiotherapy* is always ordered. *Operative treatment* may consist of tendon transplants (in cases of partial recovery) or stabilisation of joints.



Fig 209
Hendry working splint for ulnar paralysis (Naylor)



Fig 210.
Cramer wire splint for Erb palsy (Naylor)

BIRTH PALSIES

Erb's palsy is due to a traction injury to the fifth and *sixth cervical nerve roots during birth. There is paralysis of* deltoid, biceps, supraspinatus, infraspinatus, and the supinators of the forearm The arm hangs by the side in a position of internal rotation at the shoulder and extension and pronation of the forearm—the characteristic porter's hand If the condition is untreated, contractures occur and the deformity becomes fixed.

Treatment. *In very young babies the arm may be tied to* the top of the cot as a temporary measure *Splintage* is applied to hold the limb in full external rotation and abduction at the *shoulder right-angled flexion of the elbow and full supination* of the forearm A splint for this purpose is shown in Fig 48. Alternatively a comfortable and convenient splint is easily

made of padded Cramer wire (Fig 210) *Physiotherapy* is commenced at once and is directed towards preventing contractures at the elbow and shoulder As the child grows, re-education of muscles is commenced. The mother is taught to encourage abduction and external rotation of the shoulder and supination of the forearm when playing with the child. Later active use is encouraged by bandaging the sound arm to the side or by keeping it beneath the clothes. The prognosis is good.

Klumpke s palsy is a lesion of the eighth cervical and first dorsal nerve roots. There is paralysis of the intrinsic muscles of the hand, the flexors of the thumb and wrist and of the muscles of the thenar and hypothenar eminences. The fingers cannot be spread out or approximated and become clawed

Treatment. *Splintage* as for an ulnar palsy may be applied in an effort to prevent claw hand deformity *Physiotherapy* is always ordered. Later active use of the hand is encouraged, but the prospect of recovery is not good

LESIONS OF PERIPHERAL NERVES IN THE LOWER LIMB

The great sciatic nerve may be injured in deep lacerations such as gunshot wounds. It may be stretched by posterior dislocation of the hip-joint more rarely it is injured in fracture of the pelvis. In a complete lesion, there is paralysis of the hamstrings and of all the muscles below the knee there is complete anaesthesia of the lower leg and foot except for an area on the inner side of the leg Anaesthesia of the sole of the foot is a very troublesome feature and trophic ulcers quickly occur

Treatment. *Nerve suture* is followed by fixation in a plaster spica holding the hip in extension the knee in flexion and the foot in plantar flexion. Irrecoverable cases may require a caliper or double iron for weight bearing

The external popliteal nerve is very liable to injury as it is superficial where it winds round the neck of the fibula, so that it may be compressed by splints, plasters, or tight bandages. It may be damaged in dislocation of the knee or by strain or

rupture of the external collateral ligament. There is paralysis of the anterior tibial group of muscles and of the peronei, so that the foot cannot be dorsiflexed or everted, and there is anaesthesia of the outer aspect of the leg and dorsum of the foot. If untreated, an equino-varus deformity of the foot will develop.

Treatment. *Splintage* consists of a plaster shell or club-foot shoe holding the foot in right-angled dorsiflexion and slight eversion.

Physiotherapy is commenced at once. Irrecoverable cases may require a toe-raising spring or a double iron with posterior stops. An outside T-strap may be necessary.

Operative treatment may be required to correct deformity and may take the form of a stabilisation of the foot with or without tendon transplants, or some other procedure such as Lambrinudi's drop-foot operation.

CHAPTER XXX

AFTER CARE

By Mona Williams, After-care Superintendent, Robert Jones and Agnes Hunt Orthopaedic Hospital, Oswestry

Object of After-care clinics. Clinic premises. Clinic staff. Type of work done at the clinic. New patients. Preventive treatment. Patients discharged from hospital. Advantages of earl discharge from hospital. Procedure on discharge. Maintenance of plaster fixation. Gradual correction of deformity by repeated plasters. Treatment of congenital deformities. Other cases treated at a clinic. Splints. Boots. Appliance supervision. Home visiting. Visits to other hospitals. Social aspect of after care work.

It is unnecessary to stress the paramount importance of an efficient system of After-care clinics in orthopaedic work, nor should it be necessary to point out that with such an After-care service, patients can be discharged from the hospital at a very much earlier stage of their treatment

According to their size depends the frequency of the visits of the orthopaedic surgeons and the After-care sisters. Their duties at the clinics include the further supervision of the After care treatment of cases that have been recently discharged from hospital the adjustment of splints and appliances the super vision and re-application if necessary of plasters the super vision of rehabilitating exercises—in fact the continuity of treatment practically on the patient s doorstep

The After-care area is divided amongst the surgical staff and patients admitted to the hospital either as in-patients or out patients are placed under the care of the surgeon in charge of the district in which the patient lives. In this way uniformity of treatment is obtained from beginning to end in each case.

Premises. The buildings should be easily accessible ortho-paedic patients find it difficult if premises are situated on steep hills The premises themselves should be on the ground floor and certainly without steps The chief essentials are—a large waiting room, with lavatory accommodation cubicles in which

the patients can be undressed and examined, facilities for walking diagnostic X ray equipment together with viewing boxes and a plaster room with an impervious floor in which there should be a long wooden table with a deep ledge to take a hip prop. There should be an ample supply of hot and cold water, storage accommodation for surplus splints and appliances, and a shelter capable of taking prams, invalid chairs, etc. Speaking generally the lay-out of these orthopaedic clinic premises approximtae to a modified out patients department in an orthopaedic unit.

Staff. The team consists of an orthopaedic surgeon, an After-care sister qualified in Orthopaedic Nursing and possessing the certificate of the Chartered Society of Physiotherapy and a clinical stenographer when the surgeon is in attendance. The latter takes clinical notes to keep the case histories up to date.

Voluntary helpers consist of members of the British Red Cross Society and the Order of St. John of Jerusalem, the Women's Voluntary Service and members of the local Voluntary Orthopaedic Association. They undress and dress patients and in time are trained to remove and re-apply splints, bi-valve and repair plasters, lengthen or shorten callipers, serve light refreshments and generally carry out many duties of which they are quite capable and so represent a fairly large potential nursing staff.

Transport for patients. In cases where patients are not able to travel to the clinics by public transport, the sister gives details of the case and the type of conveyance required to the transport clerk at the hospital, who makes the necessary arrangements.

Type of work done at the clinics

New patients. No new patient is admitted to a clinic unless referred either by a local doctor or by the County Health Authorities. New cases attending on Sister's day are all examined by her. She obtains a history of the case and records her observations on a "New Patient" sheet in readiness for the surgeon's next visit to the clinic. If however she considers that the patient should not be kept waiting for treatment until the surgeon's visit, she refers him to the Out Patient Depart

ment at the hospital at an earlier date If on the other hand she has school-children with minor defects she makes her own notes and has a case-sheet made out marked Preventive These cases she is allowed to treat herself without referring them to the surgeon. They are —mild flat feet mild knock knees, postural round shoulders, etc If however during the course of treatment any of these conditions do not improve or become more marked she then shows them to the surgeon for further advice All new cases under the age of five years are completely undressed for examination This is very im portant, as any asymmetry in the lower limbs might be over looked.

Preventive treatment. Large numbers of school children are referred to our clinics suffering from postural defects of the spine, feet and knees. In some cases the parents say that they themselves have not noticed anything wrong with the child others state that they have noticed that the child is round shouldered, or that he walks over on his shoes. Although many of these defects are minor it is important not to ignore them for they *may* be the beginning of some more serious trouble.

Postural defects of the spine These patients must be com pletely undressed for examination The most common are the dorsal round back, sway back and kypho-lordosis. Corrective exercises are taught and where room permits the children are treated in classes. They are much keener and more interested than when treated individually An attempt should be made to find out the cause of these defects, for example eyesight might require attention. There may be a history of a chest complaint. The nervous timid child tends to stand badly or he may be a mouth breather There may be some psychological reason due to bad home conditions. In addition to the corrective exercises which must be carried out daily at home it must be emphasised that the child should sleep on a firm mattress.

Postural defects of feet and knees When children are referred with these deformities it is most important to examine the footwear as well as the feet and knees. In many cases, the defect is minimal but sometimes the beginning of a more serious deformity is discovered so that every patient must be examined

the patients can be undressed and examined, facilities for walking, diagnostic X ray equipment together with viewing boxes and a plaster room with an impervious floor in which there should be a long wooden table with a deep ledge to take a hip-prop. There should be an ample supply of hot and cold water storage accommodation for surplus splints and appliances, and a shelter capable of taking prams, invalid chairs, etc. Speaking generally the lay-out of these orthopaedic clinic premises approximates to a modified out patients department in an orthopaedic unit.

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This type of case requires tactful handling. With the type who is over-anxious about his condition much persuasion and patience is required. Another type is the one who will not carry out instructions. The surgeon's advice is ignored, and then the patient complains that he is not improving.

Procedure on discharge. Cases ready for discharge from hospital are seen by the After-care sister before they leave because she then knows what stage of treatment has been reached, and what splints or plasters are being worn. She finds out from the ward sister whether there are any special difficulties in the nursing of the patient. She explains to the patient that treatment will be continued at his local clinic and that he will still be kept in close touch with the hospital.

In the case of children parents are told to take the child to the local clinic on the first possible occasion after discharge. This is very important because they have to be taught to look after splints and plasters, e.g. children sent home in spica plasters need careful nursing to ensure that the plaster does not become wet and sodden.

All patients are encouraged to be as active as possible within reason and without doing anything detrimental to treatment. For example children in frog plasters are allowed to be placed on the floor where they move about in a room or on a lawn, with amazing rapidity. Many find their feet and walk in a fashion. These activities keep the muscles and joints which are free of plaster in good form.

Maintenance of plaster fixation. Patients discharged in plasters, particularly walking plasters, need constant supervision; for example a child suffering from pes cavus is admitted to hospital for tenotomy of plantar fascia and wrench. He is discharged home as soon as the plaster is hard. This means that the plaster must be kept in good condition for four months. Boots are worn, but as may be imagined these plasters have to stand a lot of wear and tear. The child goes to school, plays es and in fact leads a practically normal life. If care is taken grit, coins, beads, and other miscellaneous articles eir way inside the plasters. These articles invariably n irritation and if this is not investigated at an early teo a sore. These children, too seem to have a passion

thoroughly Usually the necessary shoe alterations and special exercises are sufficient if carried out properly in the home.

Large numbers of infants are referred to us from the Child Welfare Clinics. Many of these children are at the toddling stage and the complaint often is that 'baby turns her feet in when walking This of course might mean anything so that the child must be completely undressed and examined thoroughly As often as not, the defect may be negligible, on the other hand a dislocated hip might be discovered so that it does not do to disregard these complaints.

Patients discharged from hospital. All patients living within the area served by the hospital attend their local orthopaedic clinic and are the responsibility of the After-care sister This means that she is responsible for the continuation of the patient s treatment, which might be maintenance of plaster fixation splintage re-education of weak muscles, mobilisation of stiff joints, strengthening and corrective exercises, re-education in walking etc.

Advantages of early discharge from hospital

Children Parents should not be deprived of their children longer than is necessary Furthermore, the parents should be made to take responsibility for the child, and to take an active interest in the treatment All stages of treatment should be explained to them. Children should mix with other children at school who are physically normal, as far as possible. It has occasionally been noted that if a child has been in hospital for a long period, he has lost his place at home with the rest of the family and is sometimes unwanted and even treated as an intruder On the other hand, there is the type of child who, if too long in hospital receives too much attention on returning home and *demands* constant service, almost to the point of ruling other members of the family This should be discouraged.

Adults They too can become too hospitalised. *Some* are quite content to lie in bed and be waited upon. When it is time for their discharge, they just do not want to go. This type of patient is particularly difficult to deal with at a clinic. They will not make the necessary effort to rehabilitate themselves and are horrified when [illegible] returning to work is mentioned.

these immobilisation of painful joints due to osteo-arthritis, rheumatoid arthritis, injuries, sprains, plaster jackets for prolapsed intervertebral disc lesions, plaster corsets for low back ache, etc., etc. A large number of our patients are adult. Besides those who have received treatment in hospital there are those who are referred by local doctors and can be treated by conservative methods at the clinics. A high percentage of these suffer from metatarsalgia and numerous other foot defects. These are usually treated by exercises and special insoles.

Splints. The sister is responsible for measuring, ordering and fitting all splints at the clinics. Measuring a normally shaped limb is a simple matter, but when a limb is deformed much thought and patience is required to ensure that the splint supports the limb in the correct position, that it fits well without causing undue pressure, and that it is comfortable. If possible each patient (especially in the case of a child) should have a second splint in case of emergency. If a splint breaks and another is not available, the sister has to use her ingenuity to hold the correct position by some other means. Usually she makes a temporary plaster splint. Block leather splints are always made to a plaster cast which is taken at the clinic.

Boots belonging to patients are brought back to the hospital by the sister. She writes the necessary instructions for surgical alterations on a label, and attaches it to each individual pair. These are sent to the workshop, and when the work is completed the boots are taken back to the clinic. It should be pointed out here that each patient should have at least two pairs of boots or shoes.

Appliance supervision. Many of our patients, particularly those suffering from poliomyelitis, are left with some permanent disability which necessitates some form of splintage to be worn, so that when active treatment has nothing else to offer these patients are put on "Appliance supervision". This means that they only attend the clinic when they need a new appliance or an old one requires repair. If, however, the patient's condition deteriorates in any way he is seen by the surgeon at once.

Home visiting. In cases in which a patient is unable to attend the clinic the after-care sister is expected to visit him in his home. In cases where domestic conditions are good

for paddling through every puddle they come across. This, of course softens the plaster which then becomes quite useless. These plasters therefore have to be renewed quite often The next problem is the drying. Often parents find it most difficult to keep the child off his feet for the necessary drying period so that the plaster crumbles and cracks and has to be renewed once again.

Hip spicas have to be renewed occasionally but with reasonable care last some months.

Babies in frog plasters need careful nursing and attention. When these plasters do require renewal the child is admitted to hospital so that a check X ray can be taken after the new plaster is applied. They are, however discharged as soon as the plaster is thoroughly dry

Gradual correction of deformities by repeated plasters is done by the sister at the clinics, for example, deformities of the feet resulting from poliomyelitis, spastic paralysis, or relapsing club-feet. The plasters are changed at fortnightly intervals and increased correction is obtained at each change. This procedure sometimes has to be repeated at intervals during the course of treatment because in spite of good correction being obtained and the necessary shoe alterations and splintage worn afterwards, these deformities often recur It is important, however to keep the feet in as good shape as possible until the child is old enough for operative correction such as stabilisation.

Treatment of congenital deformities such as talipes equino-varus and calcaneo-valgus, Erb's palsy and congenital torticollis is carried out by the sister at the clinics as soon as possible after the birth of the baby These babies attend the clinics weekly for manipulations, stretchings, splintage, etc. The mothers are instructed how to look after splints and plasters and to report any complication such as swelling or discoloration of toes.

Other cases treated at a clinic. Apart from continuation of treatment of patients discharged from hospital very many patients are treated in plaster wholly at the clinics. These include stretching of tight tendo-achilles in cases of spastic paralysis, spasmodic valgus, plaster cylinders for Osgood-Schlatter's

disease immobilisation of painful joints due to osteo-arthritis, rheumatoid arthritis, injuries, sprains, plaster spicas for prolapsed intervertebral disc lesions, plaster corsets for low back ache etc., etc. A large number of our patients are adults. Besides those who have received treatment in hospital there are those who are referred by local doctors and can be treated by conservative methods at the clinics. A high percentage of these suffer from metatarsalgia and numerous other foot defects. These are usually treated by exercises and special insoles.

Splints. The sister is responsible for measuring ordering and fitting all splints at the clinics. Measuring a normally shaped limb is a simple matter but when a limb is deformed much thought and patience is required to ensure that the splint supports the limb in the correct position that it fits well without causing undue pressure and that it is comfortable. If possible each patient (especially in the case of a child) should have a second splint in case of emergency. If a splint breaks and another is not available the sister has to use her ingenuity to hold the correct position by some other means. Usually she makes a temporary plaster splint. Block leather splints are always made to a plaster cast which is taken at the clinic.

Boots belonging to patients are brought back to the hospital by the sister. She writes the necessary instructions for surgical alterations on a label, and attaches it to each individual pair. These are sent to the workshop and when the work is completed the boots are taken back to the clinic. It should be pointed out here that each patient should have at least two pairs of boots or shoes.

Appliance supervision. Many of our patients, particularly those suffering from poliomyelitis, are left with some permanent disability which necessitates some form of splintage to be worn, so that when active treatment has nothing else to offer these patients are put on Appliance supervision. This means that they only attend the clinic when they need a new appliance or an old one requires repair. If however the patient's condition deteriorates in any way he is seen by the surgeon at once.

Home visiting. In cases in which a patient is unable to attend the clinic, the After-care sister is expected to visit him in his home. For instance where domestic conditions are good

a patient suffering from a tuberculous spine or hip is sometimes nursed entirely at home, although this means regular domiciliary visits by the sister to ensure that immobilisation is satisfactory

Visits to other hospitals. During the course of her work the sister often has to visit other hospitals situated within the area served by the hospital because occasionally patients receiving treatment at our hospital develop some complaint which necessitates treatment in a General, Ear Nose and Throat, or Isolation hospital. They are therefore transferred to the necessary institution and the After-care sister is responsible for the supervision of their splints or plasters until their return.

It is not permissible for patients suffering from pulmonary tuberculosis to be treated in our hospital, therefore any patient with joint tuberculosis and active pulmonary tuberculosis is nursed in a Sanatorium. The After-care sister visits the patient and is responsible for his orthopaedic treatment. Looking after these patients is no easy matter Although they are nursed on beds similar to those used in our hospital so that nursing problems are minimised, it is difficult to prevent sore groins, slackened extensions, etc. We do, however find that the nursing staff at these hospitals are most co-operative and helpful and we have to remember that they are not familiar with this special branch of nursing.

In some areas when a new case of infantile paralysis is diagnosed and admitted to an Isolation hospital we are asked by the Medical Officer to visit the patient and fix him up with the necessary splintage (usually plaster shells) until the quarantine period is over and the patient is admitted to our hospital.

Social aspects of After-Care work

Crippled children are always encouraged to lead as normal a life as possible, so that when they are discharged from hospital every effort is made for them to attend the local school (unless of course they are too severely handicapped to get about on their own) There are, however many difficulties to overcome. (1) Transport to and from school (2) If the patient is wearing a hip spica or calipers, he is unable to sit in the ordinary school desk (3) The school teachers are sometimes reluctant to take

the responsibility of a crippled child. The After-care sister notifies the County Medical Officer of Health of these problems and in most cases he is able to make the necessary arrangements for the child to be educated. If possible the severely crippled child is admitted to a residential school for the physically defective

When the surgeon considers a patient physically fit to start work and he has no job to go to the After-care sister refers the case to the hospital almoner who tries to find suitable employment

There is also the problem of a patient suffering from a tuberculous lesion being discharged to an overcrowded home where sanitary arrangements are bad, and where very little fresh air is allowed. Often there is no through ventilation and in some of the houses we visit the windows are not made to open. Invariably a child has to share a bed with another member of the family sometimes two. When we are faced with the latter problem, we refer it to the hospital almoner who takes the necessary steps to provide better accommodation.

Diversional therapy On discharge from hospital, patients who are severely crippled or who are not likely to be fit for work for some time miss the companionship of their fellow patients and find life pretty dull unless they are given something to do. Fortunately while in hospital these patients are taught leather work, basket making rugmaking, weaving and various other crafts and if they wish they can be supplied with the necessary materials to continue this occupation at home The After-care sister finds out what they are best able to do and the materials are supplied from the hospital at a reduced cost In cases where the standard of work is good a market for these goods is found by the hospital almoner This is very encouraging to the cripple who is confined to the home or who is perhaps bedridden. In this way they are able to earn a little money and feel more independent

Children are often brought to clinics by mothers who make things difficult for the patient and sister alike so that firmness combined with understanding is needed to smooth over emotional crises Sometimes difficulties arise with regard to parents refusing to allow their child to come into hospital or they may

refuse to allow the child to wear a splint. Fortunately these particular problems do not arise as often now as they did some years ago and are usually overcome.

All this means that the After-care sister must have qualities which at first glance have no direct bearing on her work. She must have tact, sympathy and considerable social initiative. She has to enter a wide variety of homes, and deal with patients from every walk of life. The variety of work in After-care clinics makes it most interesting and there are other satisfactions. It is fascinating for an After-care sister to follow the course of a case right through from the time the patient comes first to the clinic is sent to hospital, and is again dealt with at the clinic until the final result is seen. There can be few more satisfying experiences in the nursing profession. Moreover the ultimate result of After-care is that there is more room at the crowded hospitals for those who cannot possibly be treated elsewhere, and this makes it such a vitally important service that its extension would solve many problems that now appear insoluble for a long time to come.

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